ENVIRON

August 11, 2000

Mr. Mike McAteer Remedial Project Manager USEPA Region 5 SR-6J 77 West Jackson Blvd. Chicago, IL 60604-3590

Re:

Enviro-Chem Site Zionsville, Indiana

Dear Mr. McAteer:

In accordance with our letter to you of January 26, 2000, the Trustees have prepared a RISC analysis (as a Technical Memorandum) of the Southern Concrete Pad using the methodology provided in the Risk Integrated System of Closure (RISC) – User's Guide, Interim Draft (Revision 1), dated February 18, 1999. A copy of the Technical Memorandum is enclosed for your review. As you will note from the document, the Trustees believe that the post-excavation samples from the Southern Concrete Pad meet the current IDEM RCRA clean closure criteria. We intend to request a meeting with IDEM, following their review of the memorandum, to respond to any questions and/or comments.

As before, the Trustees appreciate your willingness to allow us to pursue this methodology for accelerating the completion of construction at the ECC Site. If you have any questions or concerns, please do not hesitate to call Mr. Bernstein or me.

Sincerely,

ON BEHALF OF THE ECC TRUSTEES

Roy O. Ball, Ph.D, P.E.

Principal

cc:

Mr. Norman W. Bernstein, Trustee

Mr. Myron Waters, IDEM

Mr. Tim Harrison, CH2M-Hill

K7 8/00

TECHNICAL MEMORANDUM CLEAN CLOSURE OF THE SOUTHERN CONCRETE PAD AREA ECC SUPERFUND SITE INDIANAPOLIS, INDIANA

Prepared by: ENVIRON International Corporation 650 Dundee Road, Suite 150 Northbrook, Illinois 60062

> Prepared for: Envirochem Trustees

INTRODUCTION

The requirements for excavation of the soils underlying the Southern Concrete Pad (SCP) of the Environmental Conservation and Chemical Corporation (ECC) Superfund Site are set forth in Section 2.1.1 and Appendix F of Revised Exhibit A¹. Paragraph 5.3 of Appendix F specifies that the "then current IDEM RCRA clean closure criteria will be established for this site using the then current IDEM RCRA clean closure regulations and guidance." The "current IDEM RCRA clean closure regulations and guidance" is IDEM's Risk Integrated System of Closure² (RISC).

RISC provides both a risk-based default approach applicable to all sites and a flexible approach, which includes site-specific data and/or alternate models for site closure, for all IDEM remediation programs (including RCRA). The purpose of this Technical Memorandum is to compare the results of the SCP exit sampling (collected in accordance with Paragraphs 2 and 3 of Appendix F) to the provisions of RISC that apply to IDEM RCRA clean closure.

SCP EXCAVATION AND SAMPLING

A location map for the ECC Superfund Site is provided as Figure 1 and a Site base map is provided as Figure 2. The excavation of the soils underlying the SCP took place during the summer of 1998. The minimum limits of excavation were the lateral extent of the concrete pad and a minimum depth of nine feet. The maximum limits of excavation were defined in Revised Exhibit A³. The actual limits of excavation were determined by visual inspection or by field screening⁴.

² RISC is described in the User's Guide, Draft (Revision 1), dated February 18, 1999 and in the Technical Resource Guidance Document, Draft (Revision 1), dated February 18, 1999.

¹ Revised Exhibit A, May 7, 1997, Revision 2.

³ The maximum safe depth was defined based on the recommendation of an independent Indiana-registered engineer specializing in geotechnical engineering (p. 4 of Revised Exhibit A). The maximum lateral extent of the excavation was defined in Appendix F of Revised Exhibit A as the top of the bank of Unnamed Ditch to the east, the road to Northside Landfill to the south, the western fence bordering the support zone to the west, and the edge of the concrete pad to the north.

⁴ Revised Exhibit A, May 7, 1997, Revision 2, p. 2

Post excavation confirmatory soil samples (Confirmation Samples) were collected from the bottom and sidewalls of the open excavation in June and July of 1998 in accordance with Paragraphs 2 and 3 of Appendix F to Revised Exhibit A. Sample locations are shown in Figure 3. Sidewall samples were generally collected at a depth of one-half the total excavation depth. The Confirmation Samples were analyzed for Volatile Organic Compounds (VOCs) and Semivolatile Organic Compounds (SVOCs) using USEPA's Methods 8260A and 8270B, respectively.

GEOLOGY AND HYDROGEOLOGY OF THE SCP

The uppermost aquifer below the SCP is a sand and gravel unit, the top of which is present between 14 to 30 feet below ground surface (bgs). This aquifer is overlain by a low permeability till (clay to silty clay with sand) that creates a confined condition for subsurface water in the underlying sand and gravel. Figures 4 through 7 provide geological cross sections for the SCP. As shown in Figures 4 and 5, the till is thinner on the north end of the SCP (approximately 14 to 20 feet thick), but is continuous vertically. On the south end of the SCP, the till is thicker (approximately 30 feet thick), but contains horizontally discontinuous sand and gravel lenses. These lenses are generally present in the lower portion of the till. Figures 6 and 7 show that the thickness of the till does not vary significantly from east to west.

Due to the low permeability of the overlying till, subsurface water is present in the sand and gravel unit under confined conditions, meaning that the potentiometric surface (the elevation to which water will rise in a well that penetrates the unit) is higher in elevation than the top of the sand and gravel unit⁵. The potentiometric surface, as denoted with an inverted triangle in Figures 4 through 7, is located within the till. The difference between a confined and an unconfined aquifer is illustrated in Figure 8. Because the potentiometric surface of a confined aquifer is located at a higher elevation than the top of the aquifer, the hydraulic pressure forces ground water upwards. A confined aquifer is commonly described as existing under artesian conditions. Clearly, the permeability of

⁵ R. Allen Freeze and John A. Cherry, Groundwater, 1979, Prentice-Hall, Inc., pp. 48-49.

surficial geologic units and whether the uppermost aquifer is confined or unconfined has significant implications for the migration of contamination from soil to ground water⁶.

In an unconfined shallow aguifer, soil contamination in the vadose zone partitions into infiltrating rain water (leachate) and is transported due to gravity through the vadose zone to the water table, where the leachate commingles with ground water. The infiltration process is also referred to as advection. Other transport phenomena also occur in the soil, such as dispersion (caused by advection) and molecular diffusion, but they are minor compared to advection, which is the primary transport mechanism for transport of soil contamination in the vadose zone into a shallow, unconfined aquifer. This geological configuration represents a significant potential for ground water contamination.

In contrast, a confined shallow aquifer is, by definition, below an overlying lowpermeability unit. The combination of an overlying low permeability unit and the upward (artesian) pressure of the underlying ground water is a significant barrier to downward contaminant transport via advection. In the absence of advection, the only significant transport phenomenon to carry soil contamination to ground water is molecular diffusion.

The unconfined aquifer scenario, since it represents the "worst-case" geology for ground water contamination, forms the basis of the analysis of the migration to ground water pathway in many risk-based site assessment methodologies, including the USEPA's Soil Screening Level (SSL) Guidance and the American Society for Testing and Materials (ASTM) Guidance for Risk-Based Corrective Action at Petroleum Release Sites⁸. RISC has adopted the USEPA's SSL equations for the calculation of indirect contact remediation objectives. The SSL equations describe the partitioning of organic contaminants from the organic matter associated with soil into infiltrating rainwater and the dilution that occurs upon mixing of the leachate with the ground water. In other

⁶ R.C. Berg, J.P. Kempton, and K. Cartwright, Potential for Contamination of Shallow Aquifers in Illinois, Illinois State Geological Survey, Circular 532, 1984.

⁷ USEPA, Soil Screening Guidance: User's Guide (April 1996) and Technical Background Document

⁸ Standard Guide for Risk-Based Corrective Action at Petroleum Release Sites, ASTM E 1739-95, November 1995.

words, the SSL conceptual model is based on an unconfined, or water table, aquifer. The SSL User's Guide describes the applicability of the SSL migration to ground water equations⁹:

"The methodology for developing SSLs for the migration to ground water pathway was designed for use during the early stages of a site evaluation when information about subsurface conditions may be limited. Hence, the methodology is based on rather conservative, simplified assumptions about the release and transport of contaminants in the subsurface (Exhibit 12¹⁰). These assumptions are inherent in the SSL equations and should be reviewed for consistency with the conceptual site model (...) to determine the applicability of SSLs to the migration to ground water pathway."

The SSL conceptual model is thus appropriate for Tier 1 analyses where site-specific geology may be unknown. The model assumptions need to be reconsidered if a site-specific Tier 3 analysis is to be conducted. Because the ECC site-specific geology and hydrogeology are <u>not</u> consistent with the SSL/RISC model assumptions, an alternative site-specific model is needed to determine the potential impact of soil contamination on ground water.



Some of the simplifying assumptions presented in Exhibit 12 that are not applicable to the SCP are:

- Uniformly distributed contamination from the surface to the top of the aquifer;
- Unconfined, unconsolidated aquifer with homogeneous and isotropic hydrologic properties; and
- No contaminant attenuation in the aquifer.

⁹ USEPA, Soil Screening Guidance: User's Guide, April 1996, pp. 28-29.

¹⁰ Exhibit 12 of the SSL User's Guide is provided hereto as Appendix A.

As stated above, the shallow aquifer in the SCP is confined by an overlying low permeability till and the ground water is under upward (artesian) pressure. Therefore, soil contamination in the till can be transported to the underlying sand and gravel unit only by molecular diffusion. As a result, the alternative model must incorporate this transport mechanism (molecular diffusion), rather than advection.

COMPARISON OF POST EXCAVATION DATA TO RISC STANDARDS

The lateral limits of the final excavation and confirmation sample locations are given in Figure 9. Excavation depths are depicted in cross sections in Figures 10 through 13. As stated previously, the confirmation samples were analyzed for VOCs and SVOCs. The analytical results for compounds detected above the reported quantitation limits (the Confirmation Data) are presented in Table 1. In this section, the Confirmation Data are compared to the provisions of RISC that apply to IDEM RCRA clean closure. IDEM RCRA clean closure is defined in RISC¹¹ as:

"Addressing a unit that includes the decontamination, treatment and/or removal of all hazardous waste, hazardous waste constituents, hazardous constituents, leachate, contaminated run-on and run-off, waste decomposition products, liners, and contaminated soils (including ground water) that pose a substantial present or potential threat to human health or the environment. This may be achieved by obtaining closure levels less than or equal to PQLs (practical quantitation limits) for organic constituents, the mean plus two standard deviations of background for non-organics, and/or RISC Tier 1, 2, and 3 residential levels."

While Tier 2 and 3 remediation objectives are acceptable, certain restrictions apply 12:

"Tier 1 Residential closure levels are now accepted by OSHWM (Office of Solid and Hazardous Waste Management) as levels indicative of clean closure. In addition, Tier 2 and Tier 3 risk assessments utilizing residential exposure

¹¹ RISC User's Guide, Draft (Revision 1), February 18, 1999, p. 2-7.

¹² RISC User's Guide, Draft (Revision 1), February 18, 1999, p. 2-3.

assumptions may be used to achieve clean closure, however, "exposureprevention" methods will necessitate post-closure requirements. Exposureprevention methods cannot be used to demonstrate clean closure."

Exposure prevention remedies are achieved through either:

- 1. Activity restrictions, which prohibit activities that could result in exposure to contaminants at levels unsafe for human health or the environment, or
- 2. Engineering controls, which are physically designed to prevent humans or environmental receptors from having contact with, or exposure to, contaminated media¹³.

In the terminology of RISC, therefore, the requirements of IDEM RCRA clean closure are met by achieving residential Tier 1, 2, or 3 remediation objectives without reliance upon "activity restrictions" or "engineering controls" to limit exposure to residual contamination. "Closure" may be demonstrated in one of two ways¹⁴:

- 1. Every sample analysis result must be below the land use specific closure level established for each contaminant, or
- 2. The 95% upper confidence limit of the mean for the sample analyses must be below land use specific closure levels.

As a screening procedure, the maximum detected concentrations of VOCs and SVOCs were compared to RISC Residential Tier 1 Risk-Based Screening Levels (RBSLs) in Table 2. For all of the SVOCs, and for 12 of the 25 of the VOCs, the maximum detected value is below the Residential Tier 1 levels. Therefore, these compounds can be eliminated from further consideration. For the remaining 13 compounds, the 95% upper confidence limits of the mean (the "95% UCL") are compared in Table 3 to their

¹³ RISC Technical Resource Guidance Document, Interim Draft (Revision 1), February 18, 1999, pp. 4-7 to 4-8.

¹⁴ RISC Technical Resource Guidance Document, Interim Draft (Revision 1), February 18, 1999, p. 11-5.

respective Residential Tier 1 level¹⁵. The Tier 1 RBSLs for both the direct and the indirect contact pathways are shown. RISC considers the following exposure pathways in the calculation of direct contact closure levels:

- Direct contact with skin (dermal absorption):
- Inhalation of soil particulates or dust (ingestion/inhalation);
- Volatilization to ambient air (inhalation); and,
- Direct ingestion.

The indirect contact closure levels are based on the pathway of migration to ground water, with either the Maximum Contaminant Level (MCL), if available, as the target ground water concentration, or a risk-based level which considers ingestion, inhalation, and dermal contact.

As shown in Table 3, none of the 95% UCL for the 13 remaining VOCs are in excess of their respective direct contact Tier 1 level. The 95% UCL for nine of the VOCs exceeds its respective indirect contact Tier 1 level. These compounds will be carried over for comparison with land use specific closure levels.

INDIRECT CONTACT TIER 3 ANALYSIS

As discussed in the Geology and Hydrogeology section above, the SSL/RISC conceptual model for calculating site-specific remediation objectives for the indirect contact (i.e., pathway of migration to ground water) is not appropriate for this site. Therefore, a Tier 3 assessment has been conducted 16. The processes modeled in the Tier 3 assessment for migration of soil contamination to the confined sand and gravel unit considers only molecular diffusion (as a transport mechanism) through the saturated till to the underlying aquifer. Biological decay is also included in the model. The site-specific

¹⁵ For the calculation of the 95% UCL, the non-detects for the VOCs are assigned the quantity of one-half of the detection limit.

¹⁶ The conduct of a Tier 2 analysis, while helpful since it allows site-specific parameters, does not address the fundamental difference the SCP and the SSL/RISC conceptual model. RISC specifically requires the use of Tier 3 analysis (as was done here for the SCP) under such circumstances (RISC Technical Resource Guidance Document, Interim Draft (Revision 1), February 18, 1999, pp 9-1.

model also incorporates several assumptions that are also used in the SSL/RISC model, such as: infinite source (i.e., constant concentration over time); steady state concentration distribution; instantaneous and linear equilibrium soil/water partitioning; unconfined and unconsolidated aquifer with homogenous and isotropic hydrologic properties; receptor well at the downgradient edge of the source and screened within the plume; and, no contaminant attenuation in the aquifer. In addition, the site-specific model assumes a minimum separation of three feet of till between the confirmation samples and the underlying subsurface water, based on site-specific data.¹⁷ The equations for the Tier 3 transport model and the derivation of the dilution factor for indirect contact are provided in Appendix C.

CONCLUSION

The 95% UCLs of the mean for the nine remaining VOCs are compared with their respective clean closure levels in Table 4. For all compounds, the 95% UCL is less than the calculated Tier 3 closure level. The residual contamination in the SCP, therefore, achieves IDEM RCRA clean closure by meeting the RISC requirements for a residential property without reliance upon exposure prevention remedies, i.e., activity restrictions or engineering controls. Thus, a comparison of the SCP exit sampling results to the provisions of RISC that apply to IDEM RCRA clean closure demonstrates that clean closure has been achieved at the SCP.

¹⁷ This is based upon soil borings advanced at the site, the logs for which are provided as Appendix B. Figures 4 through 7 depict geological cross sections based on these boring logs.

TABLES

Table 1 **Excavation Confirmation Soil Data** ECC Southern Concrete Pad

Location:	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12*	S13	S14	S15	S16	S17	S18	S19	S20*	S21	S22	S23	S24	S25	S26	S27	S28	S29	S30
Date Collected:	6/25/98	6/25/98	6/25/98	6/25/98	6/25/98	6/25/98	6/27/98	6/27/98	6/27/98	6/29/98	6/29/98	6/29/98	7/9/98	7/9/98	7/9/98	7/9/98	7/9/98	7/9/98	7/9/98	7/9/98	7/15/98	7/15/98	7/15/98	7/15/98	7/29/98	7/29/98	7/29/98	7/29/98	7/29/98	7/29/98
VOCs	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Acetone		0.12								0.027	0.043	0.029																	1.9	
Benzene																	<u> </u>								0.006					
Bromodichloromethane								L							0.56	0.42	0.48	 _												
Chloroethane																									0.14	0.19	0.028	0.032]	
Chloroform	0.68		0.7												0.48														0.32	
1,1-Dichloroethane			1.1		6.7			1.4	18				0.019	1.4	11	2.1	9.6			0.007					0.2		0.005	0.088	0.59	
1,2-Dichloroethane																							<u> </u>		0.016				0.32	
1,1-Dichloroethene					0.79										5.7	0.91	1.4								0.019				0.052	
(cis) 1,2-Dichloroethene	6.1		14	1.8	6.8	1.4	Ĺ			Ĺ			0.058	21	40	6.3	11		0.01	0.01	Ĺ	<u></u>			1		0.022	0.008	2.2	
(trans) 1,2-Dichloroethene		0.022								l					0.86	0.83	0.43				L		L	L	0.1	0.022			,	
1,2-Dichloroethene (Total)	6.2	0.022	14	1.8	6.9	1.4							0.058	21	44	7.4	12		0.01	0.01	Ĺ		L	l	1	0.024	0.024	0.008	2.2	
Ethylbenzene	1.4	0.026			0.51									0.34	6.6		2.6								0.062	0.007			0.37	
Methyl ethyl ketone	2.7	0.028	2.5	2.6	3.1	2.6	l	2.9	1.9					2.7	3.1	2.9	3.1					2.5	L		L				1	
Methyl isobutyl ketone					1																		L					0.007	0.28	
Methylene chloride															0.72		1.7					3.8			0.075		0.015		3.7	
Tetrachloroethene					2.7										110	3.4	27	L			0.006		L				0.007	0.01	3.1	
Toluene	0.73	0.01			24				<u></u>					2.7	19	1.8	8.5		0.011	0.007	0.007		L		0.79	0.016			0.25	
1,1,1-Trichloroethane	3.1		2.6		43				34				0.016	0.53	580	70			0.008	0.078			<u> </u>		0.019		0.031	0.006	2.6	
1,1,2-Trichloroethane												<u></u>			L														0.098	
Trichloroethene					170	2		0.83					0.008		53	42	63			0.012		<u></u>					0.042	0.007	6.8	
Trichlorofluoromethane														6.4	11	39	3.3										0.005		0.08	
Vinyl chloride																					<u> </u>				0.07		0.043			Ī
m,p-Xylenes	3.1	0.04			1.1		<u> </u>							0.71	23	0.76	9.1				<u></u>				0.17	0.009			0.92	i —
o-Xylene(s)	2	0.026								L	<u> </u>			0.71	7	0.76	2.8								0.08	0.005			0.3	
Xylenes (total)	5.1	0.066			1.1]					<u> </u>			1.4	32	1.5	12				<u> </u>				0.25	0.014			1.2	Ī
				l <u></u>				<u> </u>	L																					1
SVOCs																														1
bis(2-Ethylhexyl)phthalate		0.4						_1							0.65		3.4												0.532	1
Butylbenzylphthalate															1.3	0.5														
m,p-Cresols					<u> </u>						L							L							0.417					1
1,2-Dichlorobenzene															6.5		5.8												4.162	i
Diethylphthalate					6					L															0.577					i
Dimethyl phthalate					2.6													L												
Isophorone					0.58		L																							1
Naphthalene												L			0.42		<u></u>													·
Phenol																													1.108	1

Blank Cell = Compound not detected above method detection limit.
 *SVOC's were not analized in samples S12 and S20

Table 2
Comparison of Maximum Concentration to RISC Residential Tier 1
ECC Southern Concrete Pad

	 	Maximum Detected Concentration
VOCs	RISC Residential Tier 1 mg/kg	mg/kg
Trichloroethene	0.057	170.0
Tetrachloroethene	0.058	110.0
1,1,1-Trichloroethane	1.90	580.0
Methylene chloride	0.023	3.8
(cis) 1,2-Dichloroethene	0.40	40.0
1,1-Dichloroethene	0.058	5.7
1,2-Dichloroethane	0.024	0.3
Vinyl chloride	0.013	0.1
1,1,2-Trichloroethane	0.030	0.098
1,1-Dichloroethane	5.60	18.0
Toluene	12.00	24.0
(trans) 1,2-Dichloroethene	0.680	0.9
Chloroform	0.590	0.7
Bromodichloromethane	0.630	0.56
Acetone	3.10	1.9
Ethylbenzene	13.0	6.6
Methyl ethyl ketone	10.0	3.1
Benzene	0.034	0.006
Xylenes (total)	190.0	32
1,2-Dichloroethene (Total)	2000.0	44
Trichlorofluoromethane	2000.0	39
m,p-Xylenes	2000.0	23
o-Xylene(s)	2000.0	2.8
Methyl isobutyl ketone	2000.0	1
Chloroethane	20000	0.19
SVOCs	 	
bis(2-Ethylhexyl)phthalate	300	1
Naphthalene	0.7	0.42
1,2-Dichlorobenzene	17	6.5
Isophorone	5	0.58
Diethylphthalate	450	6
Phenol	110	1.108
Butylbenzylphthalate	930	1.3
Dimethyl phthalate	2000	2.6
m,p-Cresols	2000	0.417

Notes:

- 1) Tier I soil concentrations are from RISC Technical Resource Guidance Document, Table A, Draft 2/18/99
- 2) Maximum concentrations that exceed the RISC Residential Tier 1 soil concentrations are shaded The compounds are sorted in order of the ratio of the Maximum Detected Concentration to the RISC Residential Tier 1 value.
- 3) ND Compound not detected above method detection limit.

Table 3
Comparison of the 95% UCL of the Mean Soil Concentration to RISC Residential Tier 1
ECC Southern Concrete Pad

	RISC Resid	dential Tier 1	
VOCs	Direct Contact mg/kg	Indirect Contact mg/kg	SCP Data 95% UCL of the Mean mg/kg
Trichloroethene	48	0.057	21.87
Tetrachloroethene	50	0.058	11.28
Methylene chloride	120	0.023	0.71
1,1,1-Trichloroethane	2,400	1.900	57.47
cis-1,2-Dichloroethene	119	0.400	6.37
Vinyl chloride	0.31	0.013	0.16
1,1-Dichloroethene	1	0.058	0.69
1,2-Dichloroethane	4	0.024	0.12
1,1,2-Trichloroethane	10	0.030	0.13
1,1-Dichloroethane	1,400	5.600	3.06
Chloroform	3	0.590	0.20
trans-1,2-Dichloroethene	190	0.680	0.22
Toluene	1,800	12.000	3.71

Notes:

- 1) 95% UCL values that exceed the RISC Residential Tier I Indirect Contact soil concentrations are shaded in blue.
- 2) The compounds are sorted in order of the ratio of the RISC Residential Tier 1 Indirect Contact to the SCP Data 95% UCL of the mean.

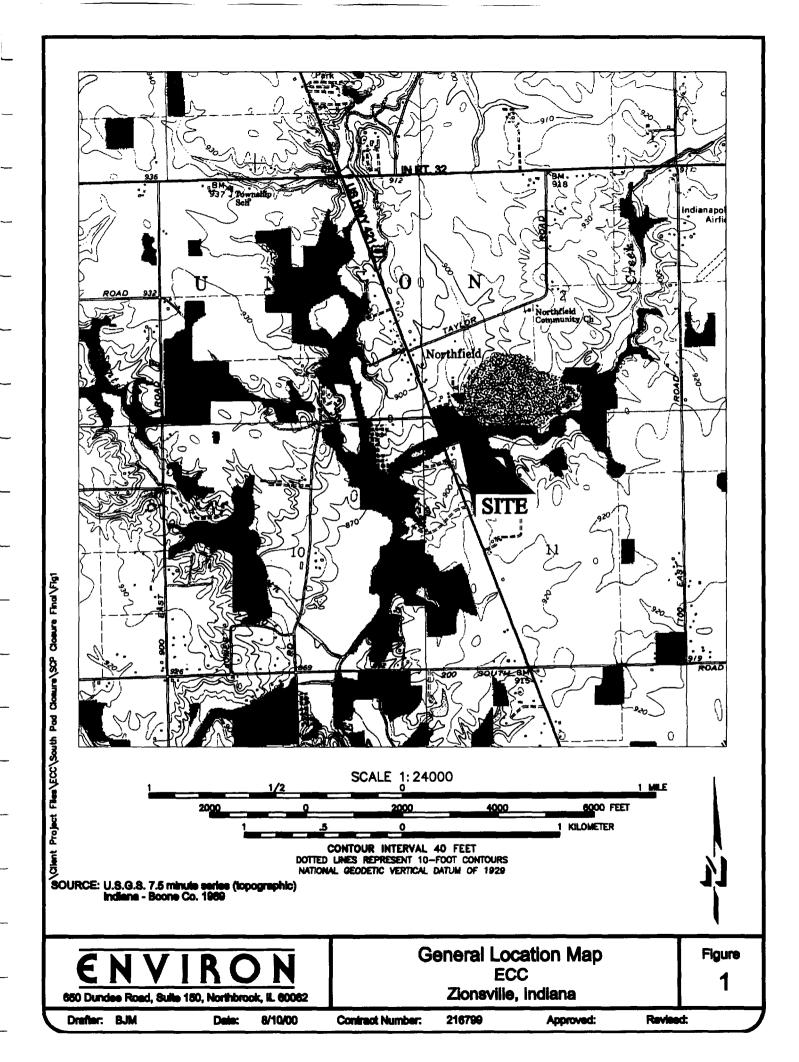
Table 4
Comparison of the 95% UCL of the Mean to Tier 3 Concentrations
ECC Southern Concrete Pad

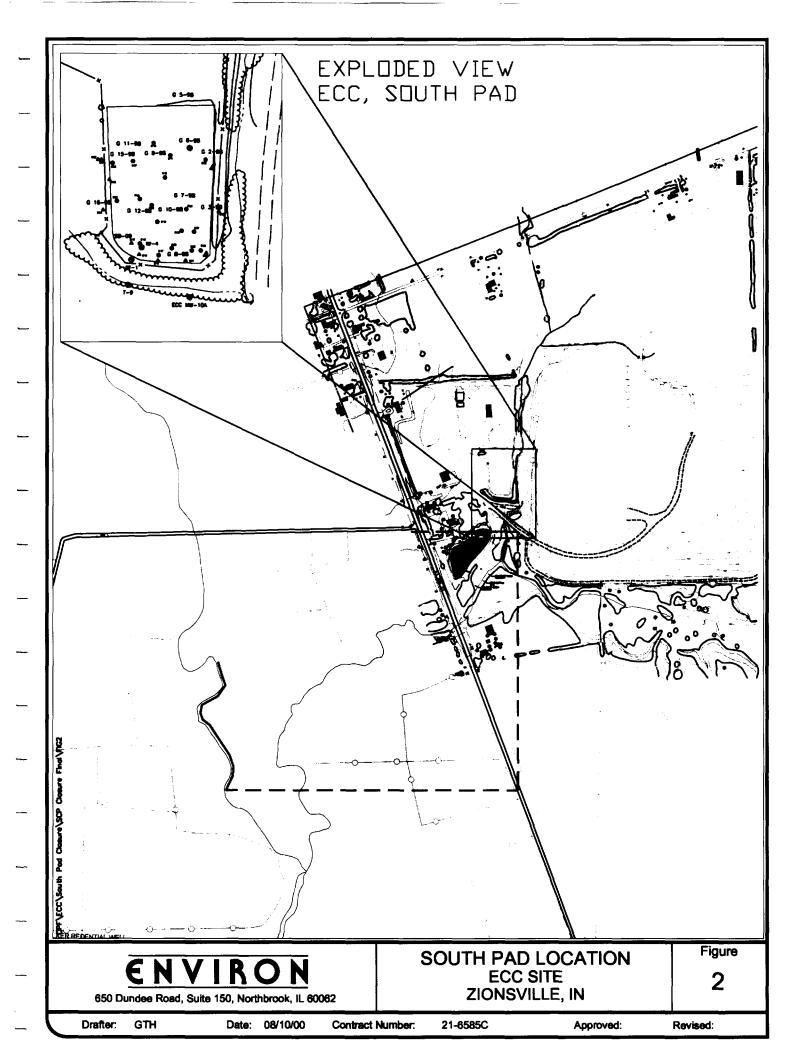
Compound	Calculated Tier 3 mg/kg	95% UCL of the Mean mg/kg
Trichloroethene	23.43	21.87
cis-1,2 - Dichloroethene	22.63	6.37
Tetrachloroethane	237.18	11.28
1,1,1 - Trichloroethane	14287 [Csat]	57.47
1,1,2 - Trichloroethane	60.87	0.13
1,2 - Dichloroethane	191.17	0.12
Vinyl Chloride	836.57	0.16
1,1 - Dichloroethene	161538 [Csat]	0.69
Methylene Chloride	13000000 [Csat]	0.71

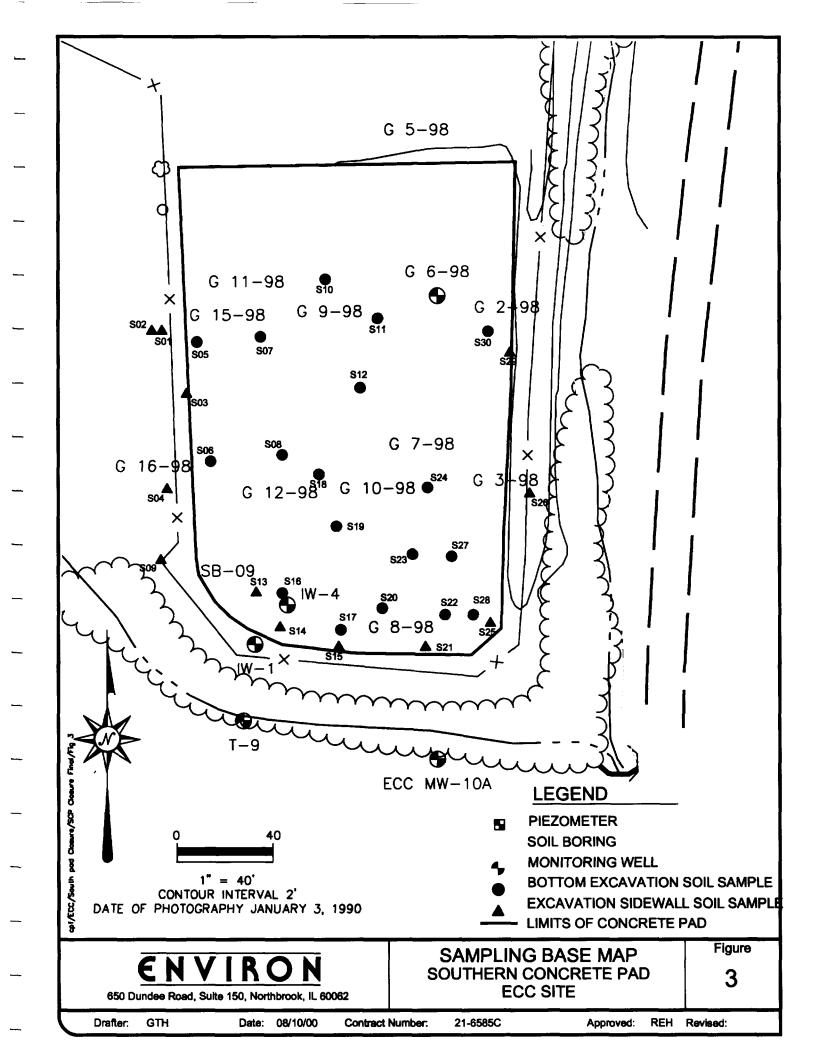
Notes:

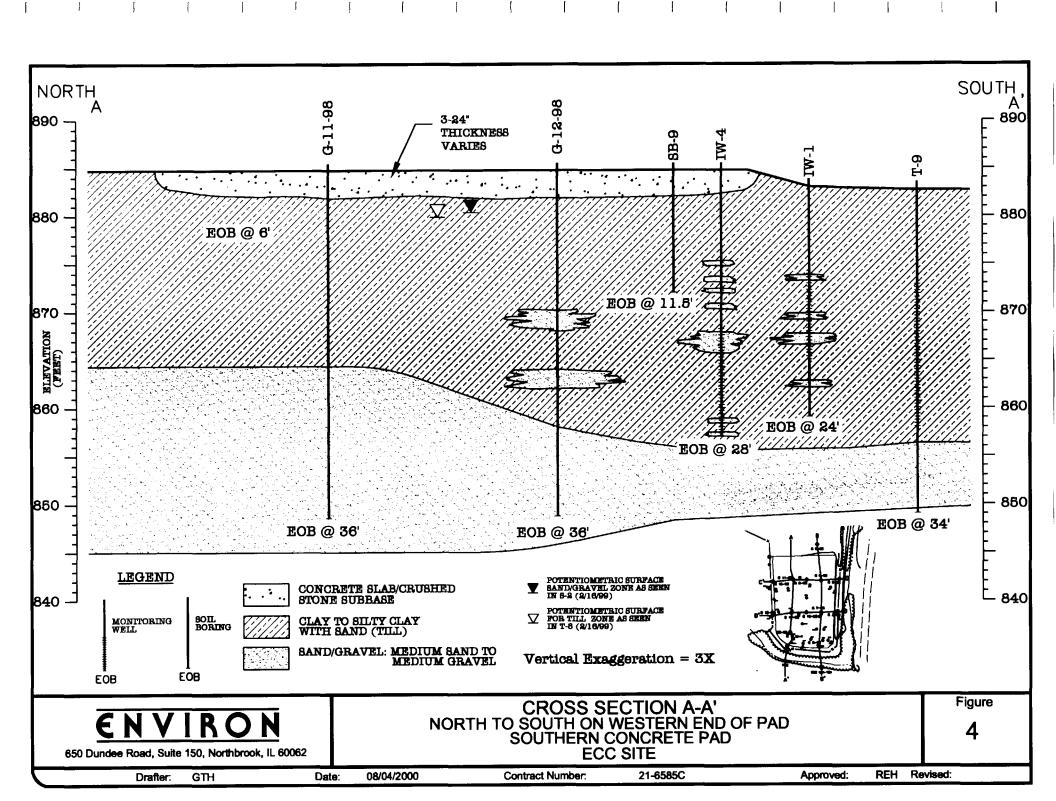
- 1) Csat = Soil saturation limit.
- 2) The compounds are sorted in order of the ratio of the 95% UCL of the mean to the Calculated Tier 3 value.

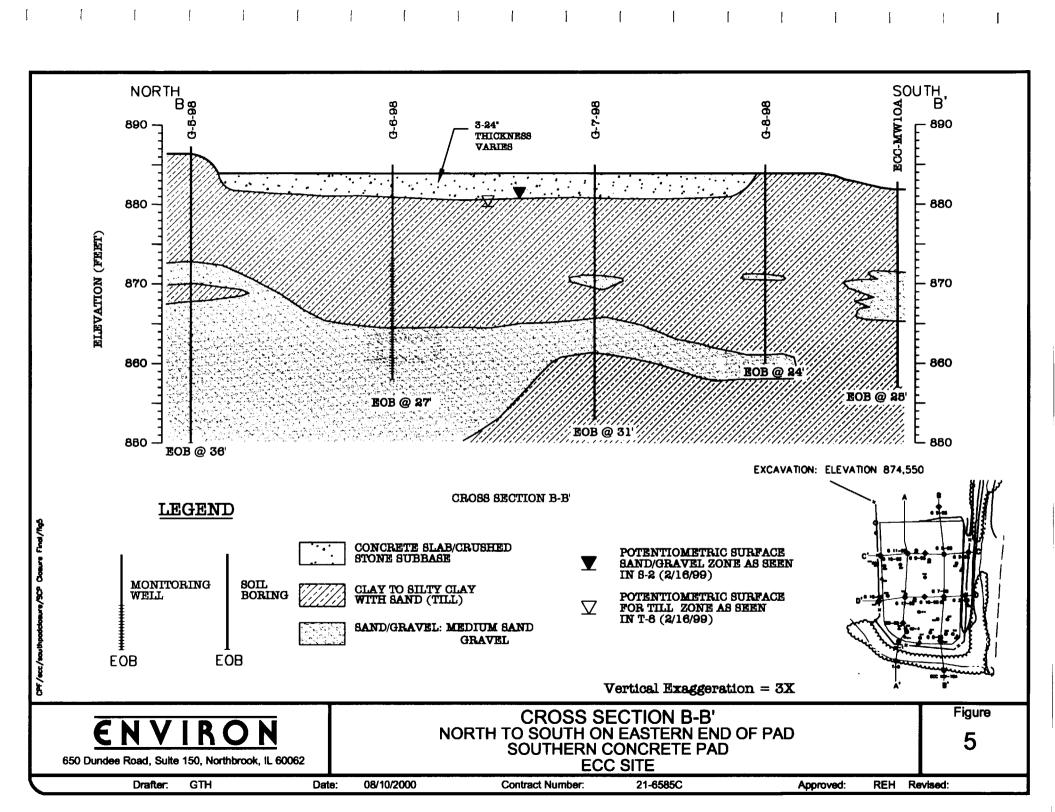
FIGURES

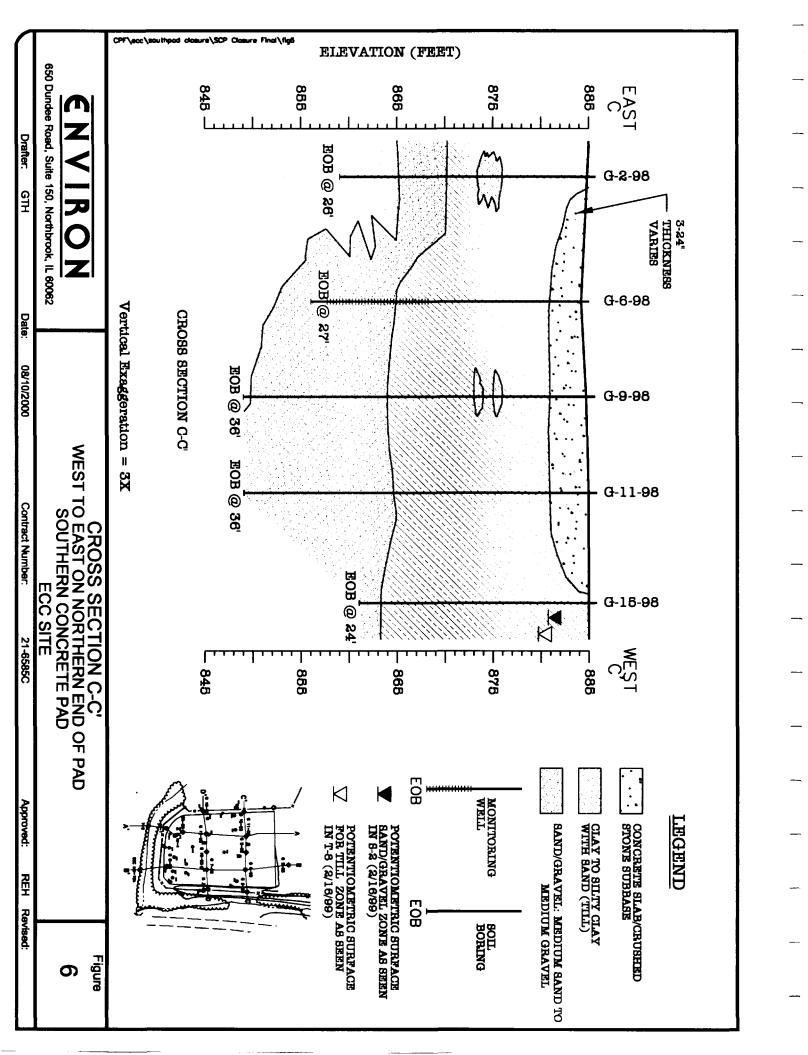












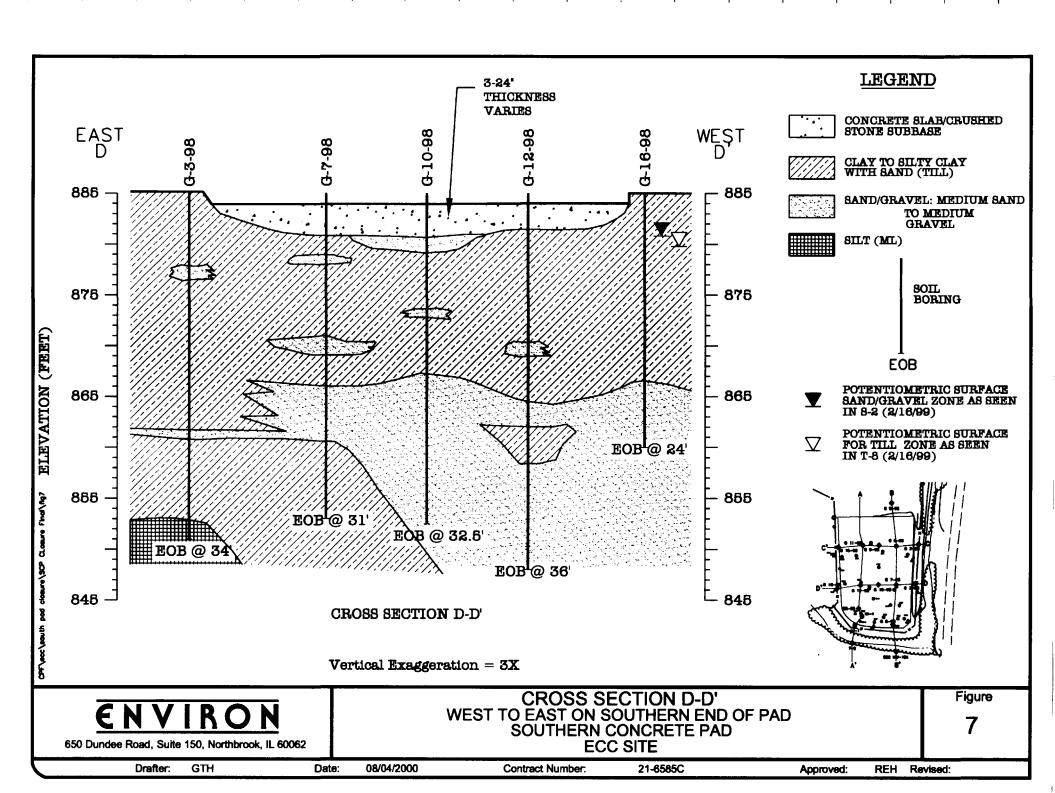
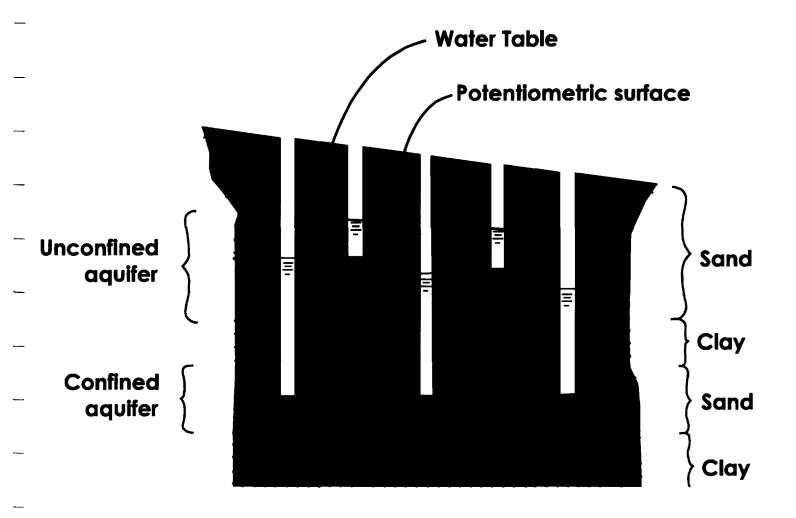
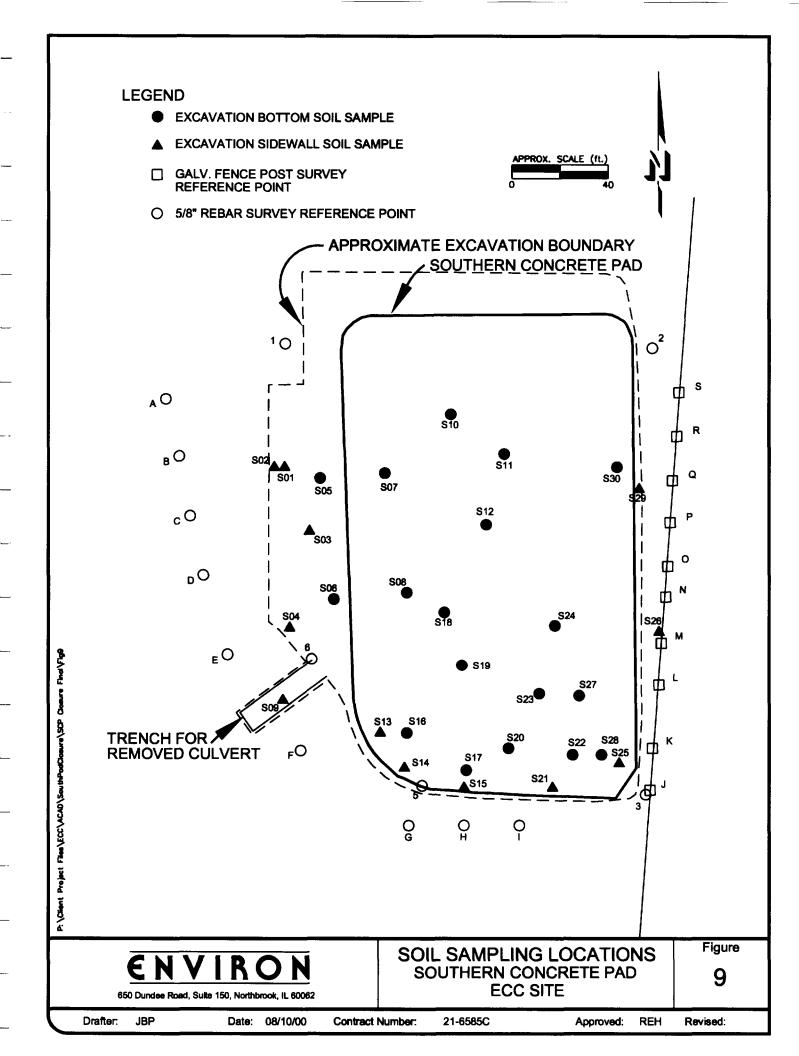


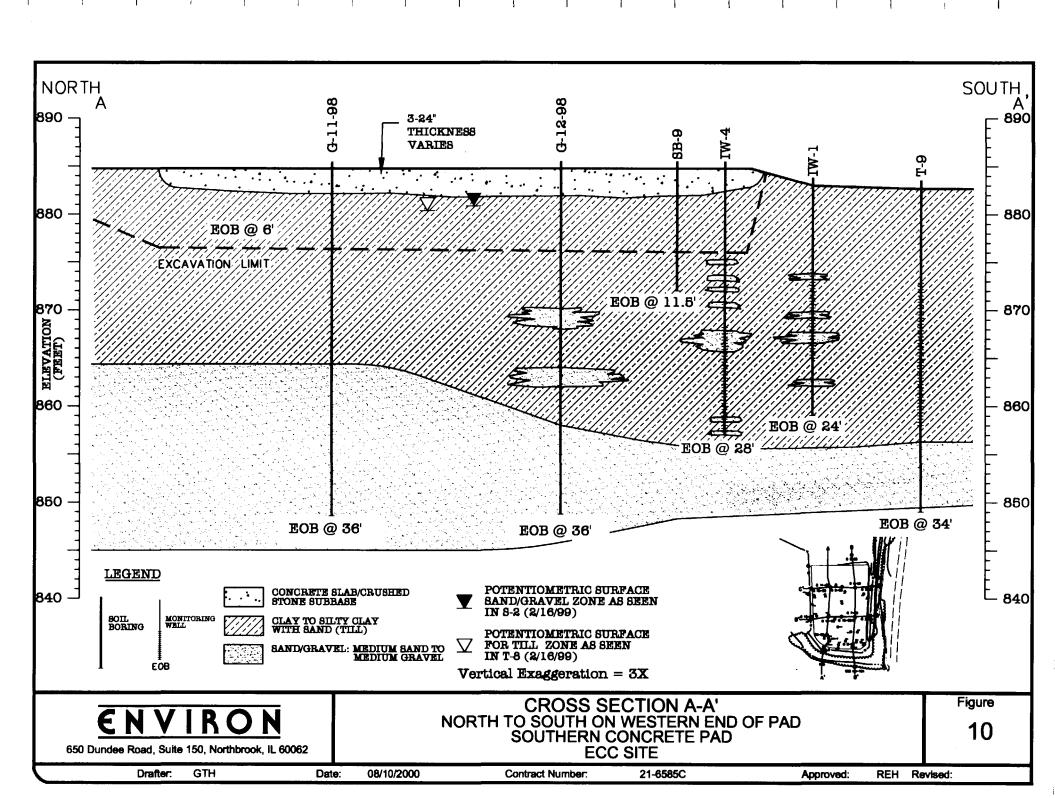
Figure 8

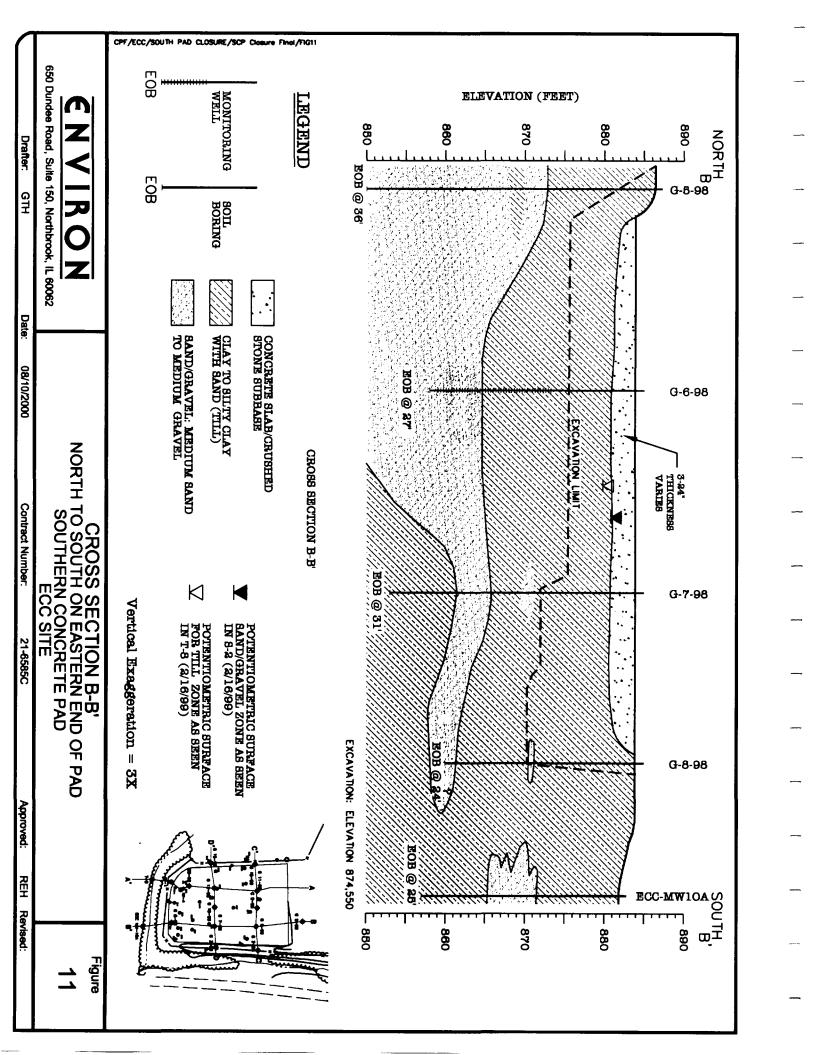
Confined and Unconfined Aquifers

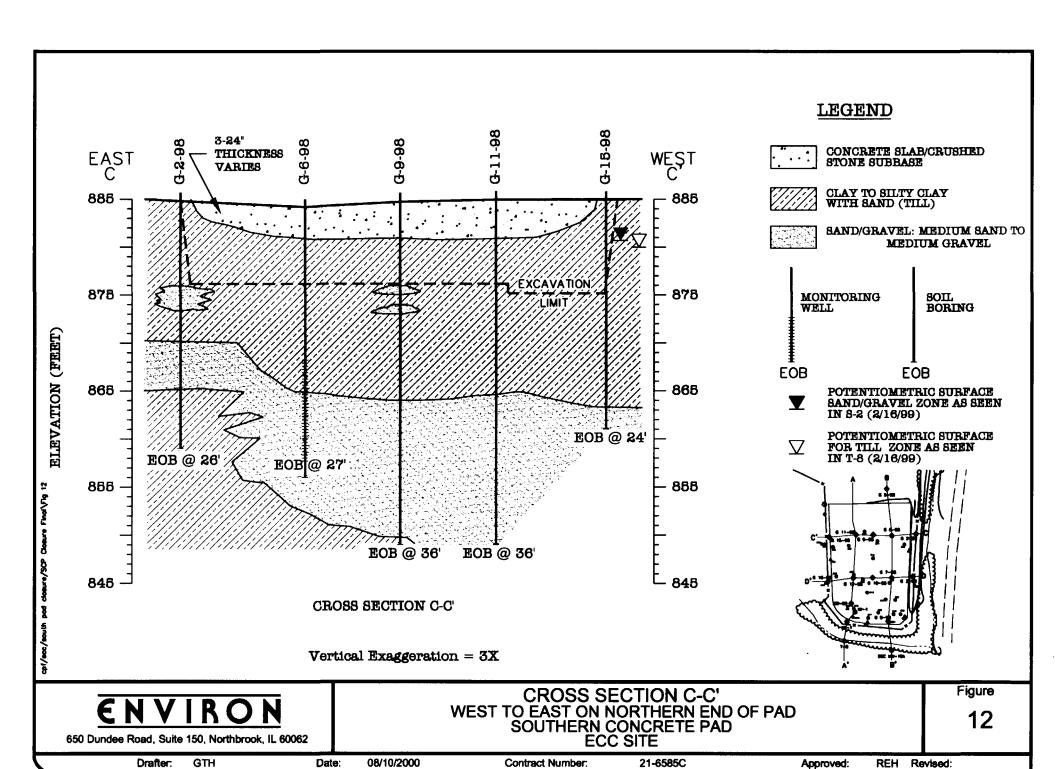


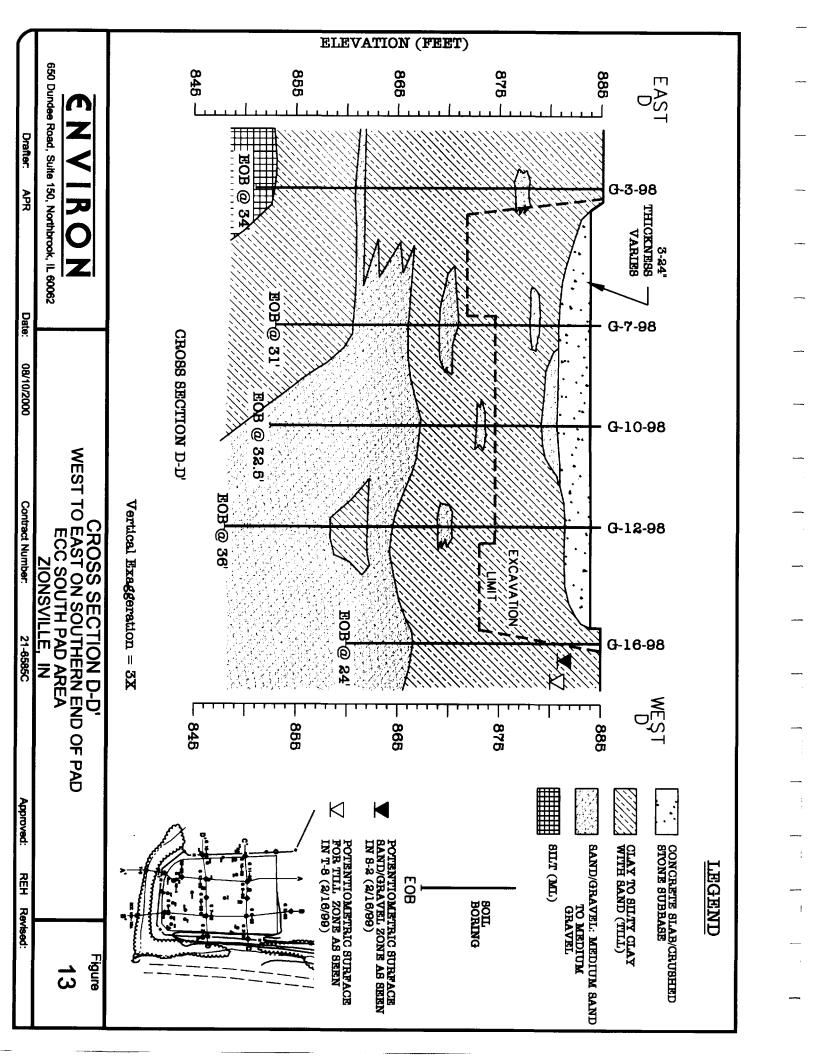
^{*} Adapted from R. Allen Freeze and John A. Cherry, <u>Groundwater</u>, (New Jersey: Prentice Hall, 1979) P. 48.











APPENDIX A

Soil Screening Guidance Exhibit 12

Exhibit 12: Simplifying Assumptions for the SSL Migration to Ground Water Pathway

- Infinite source (i.e., steady-state concentrations are maintained over the exposure period)
- Uniformly distributed contamination from the surface to the top of the aquifer
- No contaminant attenuation (i.e., adsorption, biodegradation, chemical degradation) in soil
- Instantaneous and linear equilibrium soil/water partitioning
- Unconfined, unconsolidated aquifer with homogeneous and isotropic hydrologic properties
- Receptor well at the downgradient edge of the source and screened within the plume
- No contaminant attenuation in the aquifer
- No NAPLs present (if NAPLs are present, the SSLs do not apply).

APPENDIX B

Soil Boring Logs

W	WC NEW MC ENVIRONMENTAL RISK MANAGEMENT								Field Boring Log Page 1 of								
1								ring N	lo	G	-2-98	3	_ M	Monitor Well No. <u>MW-G2</u>			
Project	Name	Enviro-	Chem Superfu	und Site			Site	e Loc	ation			JS 4	21, 2	Zionsville,	ndiana		
Surface	Elevation	885.1	Comple	tion Depth	26.0	ft bgs	Αυ	ger D	epth_	24	l ft b	gs	_ Ro	otary Depth <u>ft bgs</u>			
Quadrar	Quadrangle Rosston Sec. T. R. UTM (or State								art	1/:	29/9	8	_ Fin	inish <u>2/4/98</u>			
Plane) C	r State Coord. N.(X)	921737.8	B E.(Y)	725	941.9		Water Level:								¥ ft	bgs	
Latitude	<u> 39° 5</u>	7'	Longitude	86° ·	16 '				SAN	/PI	FS			PERSONNEL			
	ocation <u>Sout</u>						\vdash	T •					Γ-	Geologist -			
Drilling E	Equipment and M	Method CME	-75			T	۽ ا	ě	Sample Recovery (inches)		۔ ا	§	g G		Dave EN	-	
			 -		Graphic	Depth	Sample No.	Sample Type	e la s	(E)	alue ws/6	sture	PID Reading (ppm)	Helper - Helper -	Justin		
Elevatio			OF MATE		2 ق	ءٌ ۵				ð	≥ §	S S	ē ģ	RE	MARI	KS	
E	1		Sand medium : surface (CL F			=	64	Λ	6	.75 B	NA	15	7.3				
884.1						1	1	IX									
883.1						£ 2		<u> </u>	V	<u>L</u>							
E						E	65	N	12	1.75 P	4		000 +		,		
882.1						3		IX		 	3 4						
881.1						E 4		V	\bigvee	<u> </u>							
E				,		E"	66		16	1.6	4 4	15	127				
880.1						_ 5		IX			4						
879.1						<u> </u>		V	1		١						
E	SANDY CL	AY stiff, dark	gray (CL)			Ē	150	Λ	20	1.4 B	2	21	10				
878.1	C		Ll	_		_ 7		IX			4 5			12" Steel C	asing inst	alled	
877.1			bles at 7.3 fee			<u>-</u> - <u>7</u> 8		$V \setminus$				İ		to 7 feet.	•		
E ***	CLAY soft and gravel		iff, gray, trace	sand		= 0	151		2	0.5 P	ST	25					
876.1			coarse graine	d,		_ 9							,	i		•	
875.1	loose, gray	(57)				= 10						_					
E */3.1					4.4	- 10	152	$\sqrt{2}$	4	NP	NA	-	NA		·		
874.1						_ 11		X			İ			Bottom of E 874.9 +/-	xcavation	1 81	
873.1		stiff, gray, ti	race sand, little	e i		12		$/\setminus$									
E ***	gravel (CL)					- '-	153	\setminus	14	1.0 E	3 5	9	0				
872.1	UW=147 p	cf				_ 13		X			5 7						
871.1							ļ	$/\setminus$									
E 8/1.1		ADED SAND se, gray, trace	medium to co	arse		- 14	154	$\overline{\ \ }$	14	NP	1 2	-	0				
870.1		. 0: = 77300	. g. c. c. (61)			15		X			3						
					× E			/									
869.1 					W.F	- 16	155	\ /	10	NP	1 3	-	0				
868.1					×E	- 17		X			5						
=					XE			/			5						
867.1	POORLY GRA	_			Ø.	- 18	156		18	NP	4	-	0	Cc = 0.96			
866.1	gray (SP)	aise Aigiued,	, medium dens	e,	XE	- 19		\mathbf{Y}			8		1	Cu = 7.5			
=	Gra	evel lens at 1	9.8 feet		»E			$/ \setminus$			7		-				

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Ve	VCI SIII MG ENVIRONMENTAL RISK MANAGEMENT								Bori	ng l	Log		Page2 _ of2					
						Boring No. <u>G-2-98</u>						_ Mc	Monitor Well No. MW-G2					
1	ime Envi																	
Surface E	levation885.1	Completi	on Depth	26.0	ft bgs	Aug	ger De	pth _	24	ft b	gs_	Ro	tary Depth_	ft ba	\$			
	e Rosston	Sec	т	R		Dat	e: Sta ter Le	irt	1/29/98				ish <u>2/</u> 4	1/98				
UTM (or S Plane) Cod	UTM (or State Plane) Coord. N.(X) 921737.8 E.(Y) 725941.9								₮ 8.	0 ft	ogs	_ At	Completion	<u>▼ ft</u>	bgs			
Latitude_	Latitude 39° 57' Longitude 86° 16' "							SAN		ES			PEI	RSONN	IEL			
Boring Loc	Boring Location Southern Concrete Pad Excavation Area							Set					Geologist -					
Drilling Eq	uipment and Method <u>C</u>	ME-75		ုဒ္ဓ	_ <u>8</u>	ž	Sample Type	Sample Recovery (inches)	_	.9	تر ج (۶)	PID Reading (ppm)	Driller - Helper -	Dave Ellis Justin				
	DECODIDA	LOE MATERI		ar s	Depth (feet bgs)	Sample No.	JQ E	PE SON	Op (tsf)	Valu	foistu onten	5 E &	Helper -	-				
Elevation	DESCRIPTION LEAN CLAY with S				- B	15		14		3		0	K	MARK	S			
864.1	gravel (CL)				是21		V		В	12								
E					Æ		$ /\rangle$			21								
863.1					F 22	158	3/ /	14	4.5 + P	6 10	-	0			•			
862.1					上23		IX			13								
E	Sand lens	s at 23.6 feet.			集		$\langle \rangle$			14								
861.1					手 ²⁴	159	1	18	-	7	-	0	:					
860.1					25		ΙX			14 16								
859.1					£ 26													
-855.1	Boring terminated at grouted with cemen		ie															
					ļ													
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	i																	
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PROJECT TITLE ENVIRO-CHEM BORING NO. G-2-98 WELL NO. G-2 LOCATION ZIONSVILLE, IN COMPLETED 1-29-98 DATE STARTED 1-29-98 DRILLER DAVE ELLIS DRILLING CONTRACTOR PHILIP ENVIRONMENTAL FLUIDS NONE GEOLOGIST STEVE CONWAY, HANDEX RIG No. CME-75 METHOD HSA COMMENTS N 921,799.89, E 725,948.40 PROTECTIVE RISER CAP TOP OF CASING ELEVATION 887.3 APPROXIMATE EXISTING GROUND SURFACE EL 885.12 MSL XXX XXX XXX XXX VXVXVXVXVXVXVX 12" DIA.— STEEL CASING BENTONITE/CEMENT BOREHOLE DIAMETER BENTONITE - BOTTOM OF BORING WELL CONSTRUCTION NOTES: 1. TYPE RISER ABOVE W.T. 2" PVC 2. TYPE RISER BELOW W.T. 2" PVC RISER STACK 3. TYPE OF SCREEN 0.010" CONT. SLOT PYC MONITORING WELL INSTALLATION DIAGRAM 3. TYPE OF PROTECTIVE CASING STEEL

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Vel'Saling

4. ELEVATION OF WATER 878.13 FT

5. WATER LEVEL READING ON 9.0 FT BELOW TOC FEB 24, 1998

WEI'N I HO ENVIRONMENTAL RISK MANAGEMENT							IT	Field Boring Log Page 1							<u>1</u> of _	2		
j								ring N	ю	G	-3-91	3	_ M	Aonitor Well No				
Project	Name	Enviro-	Chem Superfund	Site			Sit	e Loc	ation		ļ	US 4	21, 2	Zionsville,	Indiana			
Surface	e Elevation _	885.2	Completion	n Depti	h <u>34.0</u>	ft bgs	Au	ger D	epth	3:	2 ft t	gs	_ Ro	otary Depth <u>ft bgs</u>				
		ton	_ SecT	•	R.		Date: Start 1/23/98 Finish 1/26/98 Water Level:											
Plane) (E.(Y)				Du	ring D	rilling	<u>¥9.</u>			_ At	Completion	<u> </u>	bgs		
	Latitude 39 57 Longitude 86 16 Longitude 57 Longitude 16										ES		· · · · · · · · · · · · · · · · · · ·	PERSONNEL				
]			te Pad Excavation	on Are	8			.		Serucines Caracteristics			_	1 -	ist - C. O'Neil Dave Ellis			
Drilling	Equipment er	d Method <u>CME</u>	-75		Graphic	Depth (feet hos)	Sample No.	Semple Type	mpde.	Op (tsf)	Value ows/6")	olsture ntent (%	PID Reading (ppm)	Helper - Justin Helper -				
Elevation	1		OF MATERIA stiff to very stiff,		\& \cdot \cd	ے م	10		0 6 1 4	_		ž ວິ 21	E S	RE	MARI	(S		
884.2	brown		ay mottled, trace			1				P	2 2 1					•		
883.2		•				2 3	11	\bigvee	9	1.5 P	2 3 2	18	0		•	•		
-882.2	UW=1	31 pcf SG=2.7	2	•				N			4							
-881.2 - - - - - - - - - - - - - - - - - - -						E 5	12	V	12	2.0 P	1 4 3	21	2.7					
879.2						6	13	V	20	1.9	2	21	26					
878.2		SILT stiff, gray,	trace organics (MI	u		7	'3	X	120	B	2 2 3	21		12" Steel C	asing inst	alled		
877.2	1	9 pcf SG=2.64 GRADED SAND			<u> </u>	E 8	14		16	NP	1	18		10 7 1421.				
876.2		grained, brown (<u>¥</u> 9					2 2							
E			hard, brown and			= 10		$\langle \ \rangle$	_									
875.2		8 pcf SG = 2.74					15	\bigvee	20	4.1 B	4 10 11	13	20.6					
-874.2 -	0.000	s with isolated s lenses.				12		$/ \setminus$			12			Bottom of E 874.1 +/-	xcavation	at		
873.2 - 872.2		LĀŸ/ČLĀŸĒŸŠĀ e gravel (CL/SC)	AND very stiff,			13	16	\bigvee	20	2.2 S	4 6 9 9	9	8.3					
		Sand lense at 1	3.5 feet			14		/			•			•				
871.2 		Y with Sand ver gravel (CL)	y stiff to hard,			- 15	17	\bigvee	20	5.3 B	5 8 11	9	19					
870.2	UW=150	Sand lens at 15	.5 feet			16		Δ			11							
869.2	544 = 150	.				- 17	18		16	4.5+ P		•	18		•			
-868.2 - -								\bigwedge										
-867.2							19		10	2.9 B	6	11	1.8					
-865.2	UW=144 j	oct			#	19		Λ			9							

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Ve	INC ENVIRONMENTAL RISK MA	NAĠEI	MENT	•				_				<u>2</u> of <u>2</u>
Project No	. <u>3709.001</u> County <u>Boo</u>	one			_							No
Droiget Na	Enviro-Chem Superfund Site			Site I	Locatio	on _		U	5 42	<u>1, Zi</u>	ionsville,	Indiana
Surface El	evation 885,2 Completion Depth	34.0 ft	t bgs	Auge	r Dept	th	32	ft bg	\$	Rot	ary Depth	ft bgs
Quadrangl	e Rosston SecT			Date:	Start	<u>.</u>	1/2	<u>3/98</u>		Fini	sh <u>1/</u>	26/98
UTM (or S Plane) Coo	tate ord. N.(X) 921664.5 E.(Y) 7255	41.5		Durin	g Drilli	ing <u>V</u>			gs	At '	Completio	Y ft bgs
	39° 57' Longitude 86° 1				SA	AMI	PLE	S	-1			RSONNEL
	ation Southern Concrete Pad Excavation Area				2	nche			5	₽		- C. O'Neil Dave Ellis
Drilling Equ	uipment and Method <u>CME-75</u>	Graphic Log	pth et bgs)	Semple No.	Sample Type	Sample Recovery ((tst)	N Value (blows/6")	olsture intent (9	Dm)	Helper - Helper -	Justin
Elevation	DESCRIPTION OF MATERIALS	2 3	2 5		S.		ි 3.8	zē:	ž ຽ 13	8.3		EMARKS_
E	LEAN CLAY with Sand very stiff to hard, gray, trace gravel (CL)		E	20	\mathbb{N}	**	3.6 B	9	.	0		
864.2	8.077		E 21		X			12 16				
E	Sand lens at 22 feet		_ 22	21	<u> </u>	20	4.5	10		0.8		•
863.2	55.70 10710 51 22 7001		F	• '	$\left \left \right \right $		В	14	-		· .	
862.2			E 23		ΙĂΙ			16				
861.2	POORLY GRADED SAND medium to coarse graded, medium dense gray (SP)		E 24	22	$\langle - \rangle$	20	4.4	1.0	11	1.3	.	•
E	LEAN CLAY with Sand very stiff to hard,		=	1	M		В	15 20				
860.2	gray (CL)		- 25 -		$ \Lambda $			24				
859.2			E 26	23	()	17		17	11	1.3	1	
E			E 27		$ \bigvee $		S	18 23				
858.2	• . •				$ \Lambda $			34				
857.2			28	24		22		10	10	2.4	1	
IE I			_ _ 29		V]	S	21 25				
856.2			= -		/			47				
855.2	Grades to LEAN CLAY		30	25	1	12	\$.5 +	20 50	12	6.1	1 .	
855.2 - 855.2 - 854.2			= = 31	i	V		•	50/4				
854.2			Ē.		/							
853.2	SILT hard, gray, with interbedded clay		_ 32 _	26	1	12	4.7 S	47 43	7	٠	1	
852.2	streaks (ML)		□ □ 33		ĮΧĮ	`	-	50	<u> </u>			
852.2					\mathbb{N}		!	50/3.				
E _{851.2}	Boring terminated at 34 feet and tremmie	шШ	_ 34								Ţ.	•
	grouted with cement-bentonite grout.											
			•						· .			
							,				1.	
									1			•
									1	•		

W	el.v	S T INC	ENVIRO	NMENTAL RI	SK M/	ANAGI	EMEN	T	Fiel	ld E	Sorii	ng I	Log		Page _	1 of 2
																No
Project i	Name	E	nviro-Cher	n Superfund	Site			Site	Locs	tion			<u>JS 4</u>	21,	<u>Zionsville,</u>	Indiana
																ft bgs
Quadran	ngle _ Ros	ston	Se	sc T.		_ R	· ·	Date	e: Sta er Lev	rt	1/3	31/9	8	_ Fi	nish2	/5/98
																n 🔻 ft bas
Latitude	39•	<u>57 '</u>	Lon	gitude <u>86</u>		<u>6 · _ </u>			S	AN	1PL	ES			PE	RSONNEL
Boring L	ocation	Southern C	oncrete P	ad Excavatio	n Are	<u> </u>				(inches)					Geologist	- Steve Conwa
Drilling E	Equipment	and Method	CME-75			Γ ₀	T :	ي ا	ě	٤			. ž	<u>و</u>	Driller - Helper -	Dave Ellis Justin
				·		Graphic Log	e pth	Semple No.	Sample Type	Sample Recovery	Op (tef)	Value ows/	Moisture Content (%)	2 E	Helper -	<u>, , , , , , , , , , , , , , , , , , , </u>
Elevation				MATERIA		52	దీ కి	76	1	8 8	2.0		13	E 9	· R	EMARKS
E	to bro	own and gra	y mottled,	to hard, bro trace gravel,	wn		E	"	\mathbb{N}		P	2 2	'			
885.6	brick	and ash (CL	FILE)		•		F 1		ΙĂ		·	3				
884.6		•					E 2	77		17	3.0	3	14	0	4.	• • • •
E							Ē.	"	\mathbb{N}		P	5				•
883.6			,	•			<u>⊢</u> 3	-	ΙĂ			11				
882.6	1						<u>-</u> 4	78	$\langle \cdot \rangle$	22	4.5	4	11	3.4	. .	
E									\mathbb{V}			8			i .	
881.6							- 5 -	ĺ	M			10				•
880.6							<u> </u>	110	$\langle - \rangle$	24	1.6	8	11	205	·	
E							Ξ,		\bigvee		s	7				
E-879.6	CLAY (CL)	very stiff, b	rown and g	ray mottled			_ 7 		$ \Lambda $			7.		•	12" Steel to 7 feet.	Casing installed
878.6	(CL)	•					_ 8	111		24	3.2	ST	11	NA	1	•
E		Sand le 144.2 pcf S	ens at 8.5 f	eet.			<u> </u>									
877.6	UW=1	144.2 pti 3	G = 2.80 ·	•			-									
876.6	•						- 10	112		16	3.1	4	11	0.6	Bottom of	Excavation at
F							_ 11		Υl		B	5			875.8 +/	
= 875.6 =							- '		$/\!\!\setminus\!\!\! $			8				
874.6	SAND	CLAY very s	tiff, gray ((CL)	—£		12	113	$\langle \cdot \rangle$	19	3.5	5	10	0.6	1	
		• *					- 13		VΙ	•	P	5				
—873.6 —	Fine C	GRAVEL lens	es at 13.1	and 14 feet.					$/\backslash$			7				
= 872.6	SILTY S	SAND loose,	gray, trace	gravel (SM)			¥14	114	()	16	NP	4	15	0.0	1	
=				•		IIIE	- 15		ΥI	·		4				
—871.6 —		Gravel laye	er at 15.5 i	ieet.					$/ \setminus$			3	÷			
870.6		•				HE	- 16	115	()	12		4	8	0.0	1	4
= [#	- 17		VΙ		2.5	7				•
869.6 	SANDY	CLAY mediu Sand lens	m stiff, gra s at 17.3 fo						$/ \setminus $		P	13				
868.6		GRADED S				#	- 18	116	\	15	NP	1	10	1.3	1	
=		nedium to co				綖	19		\bigvee [3 6				
-867.6	time Air					쐁			\mathbb{N}			7.	. }			
- 1									A				1			

Project N	o. <u>3709.001</u> County <u>Bo</u>	oone	Bor	ring No.		G-5-9	8	Mo	onitor Well N	io.
	Enviro-Chem Superfund Site									
•	levation 886.6 Completion Depth									
	le Rosston SecT.									
LITM for S			Wat	ter Leve	ıt:			-		▼ ft bgs
	-							_ At	Completion	Y It bgs
_	39 57 Longitude 86 1		<u>_</u>	S	MI	PLES	1		PEI	RSONNEL
•	ation Southern Concrete Pad Excavation Are	8			ches				Geologist - Driller -	Steve Conwa
Drilling Eq	uipment and Method <u>CME-75</u>	و و و	Sample No.	Sample Type	Sample Recovery (Inches)		Moisture Content (%)	Reading T)	Helper -	Dave Ellis Justin
		Graphic Log Depth	Q E	E	E S	Op (tsf) N Value	onter	PTO Re (ppm)	Helper -	
Elevation	DESCRIPTION OF MATERIALS POORLY GRADED SAND medium to coarse	838-	117		12	OZ:		0.0	RE	MARKS
	grained, medium dense, gray, trace gravel			$ \mathcal{M} $		5 7			:	
865.6	(SP)	21		M		7				•
-864.6	•	美 22	118	[]	13	NP 3	┦	0.0		:
		IXXE	l	\mathbb{N}	· '	5		0.0		•
-863.6		E 23	İ	IXI		8				• •
-862.6		美 ₂₄	119	<u> </u>	15 1	IP 3	ļ ·	20	•	
			119	NA	'° '	7		0.0		
-861.6		25		IXI		11				
		E 26		VV						
860.6		X E	120	\	6 1	IP 6		0.0		
859.6		27		XI		8		ł		•
		₩ŧ		/ V		'				
858.6		28 E	121	7	3 1	IP 3		0.0		
857.6		E 29	- 1	XΙ	ı	9				
		*	L	/ V		10		.	·	
856.6		≈ = 30	122	7	6 N	P 7		0.0		•
855.6		E 31	.	ΧI		7		1		
1				/\		12				
854.6		₩ E 32	23	7	5 N			0.0		
853.6		E 33	- 1	VΙ	\	8 9				
				\wedge		13		ŀ		
352.6		34 1	24	2	4 N			0.0		
		€ 35	- [\bigvee		3 6				
51.6		% E 1		$\setminus $		9				
50.6	Boring terminated at 36 feet and tremmle	36	+	+	+	+-		\dashv		
	routed with cement-bentonite grout.									
		.		.						•
									•	
	ľ						Ì			
		1 1		1						

V	er s	THE ENV	'IRONMENTA	L RISK M	ANAGI	EMEN	T.	Fiel	d B	oriı	n g l	Log		Page _	1_	of <u>2</u>
Projec	t No.	3709.001	County _	В	oone		Bori	ing No	٠	G-	6- 9 8	3	_ M	onitor Well	No	MW-G6
		Enviro-														
1		883.9														
i .		ton					Date	: Star	٦ <u></u>							
		921433.4					WAT	er Lev	4 1 2							
i .		57				-		S	AM	PL	ES			PE	RSC	NNEL
Boring	LocationS	outhern Concre	te Pad Excay	ation Are	8]		ches					Geologist Driller -		
Drilling	Equipment ar	nd Method <u>CME</u>	-75		Graphic Log	Depth (feet bas)	Sample No.	mple Type	mple covery (in	tsn.	Value ows/8")	olsture intent (%)	S Reading om)	Geologist Driller - Helper - Helper -	Just	e Ellis in
Elevati	ion DESC	CRIPTION C	OF MATE	RIALS			8	ŝ	S &	ŏ	zē	≱ გ	£ 5	R	EM/	ARKS
E	7° COI	NCRETE above li	mestone subb	ase.	44	Ē								j		
E882.	.9		•		4.4.	Ε¹	67		6	•	:	15	-	1		•
 	20.57	CLAY FILL gray a	ad brawn tra	-	3.3			ΙVΙ			2		·			
881.	sand an	d gravel (CL-ML	FILL)					$/\backslash$	İ		2					•
E 880.	9 LEAN C	LAY with Sand a	stiff to very st	Hf,		3	68		16	·	_ :	1.1	175			
E		to brown and gra	y mottled, tra	ice		- ₹4		ΙVΙ			7 9					
E-879.1	giotai			•		=		\mathbb{N}	ł	,	12					
E 878.8	s	and lenses at 4.9	and 5.6 feet	:		_ 5 _	69	(20		5	12				
Ē						- 6		VΙ		S	7					
877.8	"		•					Λ			9					
E 876.9	,					7	160	()	15		3	13	11.0	12" Steel	Casing	installed
E.						- R		VI	[В	5			to 7 feet.		
875.9) .		•					ΛΙ		·	7			Bottom of	Excava	ation at
874.9	LEAN CL	AY very stiff, gra	y, trace sand	and		- 9	161	()	18	3.0	4	8	1.0	875.2+ <i> </i> -		
Ē	gravel (C	n				- 10		VΙ		В	8				-	
873.9 - 872.9						: "		\mathbb{N}		j	8					
E 872.9						- 11	162		24	1.8	ST	11	NA			
<u> </u>	1	1.7 pcf SG=2.6	7		<i>///</i> Æ	- 12				İ						:
E-871.9		with interbedde			/// E	12				į	- 1				٠.	
 870.9	Grades	With unterpedde	A SVIAN IGURE	- .		- 13	163	▀╁	15	1.7	2	1.2	0.0			
=					<i>////</i> =		/	\bigvee	-		3					
869.9]		•		<i>#</i>	14		$\Lambda\Gamma$		NP	5					
- - - 868.9			•		/// //	15	64	-	16	1.3	2	12	0.0			
-		Sand lens at 15.	3 feet.				-	$\sqrt{ }$			3					
867.9			•			16	- 1.	ĂΙ.			5					
	1					17		__			_			,		
-866.9 -	•					ין	65	Λ	18	1.3	3	-	0.0		•••	,
-865.9						18		XΙ		.	2 6			•		
			·			19		1					· .			•
864.9	POORLY GR	ADED SAND me	dium to coar	5 6	泽	וּן	66	$\sqrt{1}$	4 1	NP	3 8		0.0	:		
_	CITATION, INC.		,	E-17			/	\1	1				,			

Me	NO MC ENVIRONMENTAL RISK M	ANAGEMENT	Γ	Field	d B	orir	ng L	.og		Page	2_ of _ 2
	o. 3709.001 County B			ng No.	·	G-(6- 98		Мо	nitor Well N	o. <u>MW-G</u> 6
Project N	Enviro-Chem Superfund Site		Site	Locati	ion		<u> </u>	IS 42	1, Z	ionsville, I	ndiana
Project N	levation 883.9 Completion Depti	h 27.0 ft bgs	Aug	er Dep	rth	25	ft b	qs_	Rot		ft bgs
	le Rosston Sec. T.							3		sh2/4	1/98
	State 921433.4 E.(Y) 725		Wate	er Leve	ol:					Completion	▼ ft bgs
	39 57 Longitude 86			-							
_	eation Southern Concrete Pad Excavation Are		-	ر <u>د</u> ا	AM	PLI	5	- 1			Steve Conwa
-	•			٤	Inches		_	(\$	5	Driller -	Dave Ellis
Drilling Eq	uipment and Method <u>CME-75</u>	Graphic Log Depth (feet bgs)	Sample No.	Sample Type	Sample Recovery (tea	N Vatue (blows/6")	Moisture Content (%)	Reading n)	Helper - Helper -	Justin
Elevation	DESCRIPTION OF MATERIALS	Graphic Log Depth	Sea	Sa	Sa R	å	N (5)	Con	PTO Re (ppm)	RI	MARKS
Elevation	POORLY GRADED SAND medium to coarse			M			8				
862.9	grained, medium dense, gray, trace gravel (SP)	E 21	167	$\langle \cdot \rangle$	77	NP	3	-	0.0		•
		₩.E		V		İ	6				•
861.9		₩ E 22		$ \Lambda $		·	14				•
860.9		23	168	$(\ \)$	14	NP ·	7		0.0	•	
		E 24		VI			8 11				
859.9		₩ŧ ¨		Λ			14				
-858.9		25	169	()	13	NP	6		0.0		• • •
		26		VΙ			11 13			-	
-857.9		E	·	/ V			19				
856.9	Boring terminated at 27 feet and tremmis	27		1	7						
	grouted with cement-bentonite grout.								,		•
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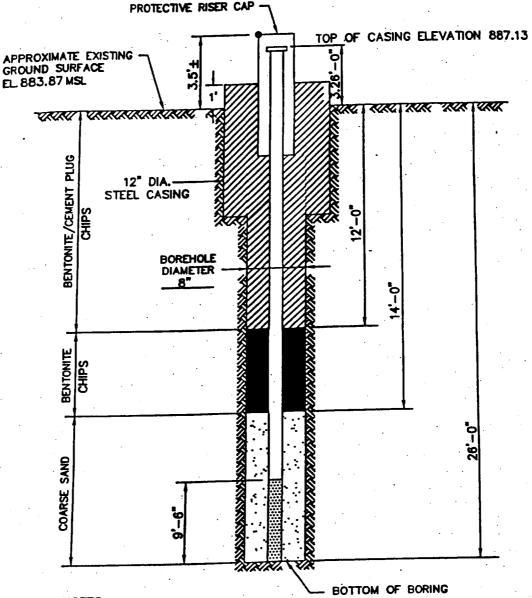
PROJECT TITLE ENVIRO-CHEM WELL NO. G-6 BORING NO. G-6-98

LOCATION ZIONSVILLE, IN DATE STARTED 1-29-98 COMPLETED 1-29-98

DRILLING CONTRACTOR PHILIP ENVIRONMENTAL DRILLER DAVE ELLIS

RIG No. CME-75 METHOD HSA FLUIDS NONE GEOLOGIST STEVE CONWAY, HANDEX

COMMENTS N 921,733.40, E 725,907.76



WELL CONSTRUCTION NOTES:

- 1. TYPE RISER ABOVE W.T. 2" PVC
- 2. TYPE RISER BELOW W.T. 2" PVC
- 3. TYPE OF SCREEN 0.010" CONT. SLOT PVC
- 3. TYPE OF PROTECTIVE CASING STEEL
- 4. ELEVATION OF WATER 878.35 FT MSL
- 5. WATER LEVEL READING ON 8.95' FT BELOW TOC

RISER STACK
MONITORING WELL
INSTALLATION DIAGRAM

MGI.V31.WC

W	el.V	THE ENV	IRONMENTAL	RISK M	ANAG	EMEN	IT	Fie	ld E	3orii	ng I	Log	İ	Page	<u>1</u> of _	_2
Project I	No	3709.001	County	Bc	oone		Во	ring N	lo	G-	<u>7-98</u>	3	Mc	onitor Well M	ło	
Project P	Name	Enviro-l	Chem Superfun	nd Site			- Site	e Loci	ation			<u>US 4</u>	<u>21, Z</u>	ionsville,	Indiana	
		883.8														<u> </u>
Quadran UTM (or	igle Ross	ton	_ Sec	т	— ^{R.} -		Dat Wa	te: Sta iter Le	art evel:	1/3	30/98	8	_ Fin	ish <u>2/</u>	3/98	
Plane) Co	oord. N.(X)_	921668.8			•											
· ·		57						_ {		/PL	ES				RSON	
_	_	outhern Concre		tion Are			ز [_		(inches)			3		Geologist - Driller -	- Steve Co Dave Elli	
Drilling E	quipment an	nd Method <u>CME</u>	-75		hic	اً ۽	Sample No.	Sample Type	Sample Recovery (<u> </u>	hue vs/6")	ture ()	PID Reading (ppm)	Helper - Helper -	Justin	•
Elevation	DESC	CRIPTION C	OF MATER	IALS	- Gran	Depth	Samı	Sam	Same	e	2 0 0 0	Mois Cont	9 OF P P P P	RI	EMARI	KS
Eleveric	10° CC	ONCRETE floor si	lab over crushed	d	44		1	十	\top							
882.8		US SOPPOSE.				:F 1	70	+	#4	NA		-	185			
E		•			44.4	Ŀ		V	"		7					
—881.8 —					44.4	· =		$ \rangle$			9				•	ļ
880.8		LAY FILL very st	tiff, brown, trac	ie .		£ ₃	71	T	18	2.4 B	5 6	16	81	 :		
E 879.8	gravel ((CL) FILL medium to c	coarse orained.	·		4		IX		-	7 8	•				
Ē.	medium	n dense, brown (S	SP-FILL)			<u>E</u> 5	L	<u>/</u>	1							
878.8	LEAN C	LAY with Sand v	very stiff, gray, 1	trace		星	72		16.	2.1 S	7	14	162			
877.8	9,5,5,	Orange staining	j at 5.0 feet	ļ		£ 6		ΙX			7 11					
876.8				.		£ 7	138	<u>, </u>	1 18	3.3	6	11	78	 12" Steel (asino inst	alled
E	1					Ē.				В	5	-		to 7 feet.		
875.8	İ					8		Λ			8					
874.8		:= -4.00.0				9	139	· · · · ·	24	4.0	ST	11	NA			
E	UW = 14	13.7 pcf SG=2.6	59			E 10								Bottom of (Excavation	ı at
E-873.8				F		Ē										
872.8						F 11	140	17	20	2.5	3	9	1.3			-
871.8		•	•	Į.		<u>-</u> 12		ΙX			4					
Ē		STADED CAND	fire preimed lov			13		$V \setminus$,							
870.8	gray (SP)	GRADED SAND	Tine grained, No)50, [************************************		= '3	141	[/	17	NP	4	10	1.3			
869.8				1. df		_ 14 _		X			4 7				•	
Ē	I FAN CL	AY with interbedo	ded sand lenses		1111	_ _ 15	142	$\langle \cdot \rangle$	15	NA	2	10	0.0			
868.8 		to hard, gray (CL				=	176	\backslash / \mid			4 8		0.0			÷
867.8						-16		Ň			6				-	
						17	143	(-)	15	4.5	4	12	0.0			
						V10		V		P	7 8					
865.8		GRADED SAND m				- 10		Λ		İ	8				٠.	
864.8	grained, n (SP)	nedium dense, gra	ay, trace gr ave i		滐	19	144	\forall	12	NP	4	11	0.0		•	
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Ver	75	INC. E	NVIRO	NMENTA	L RISK N	AANA	GE	MEN	T	Fie	eld l	Bori	ng	Log)	Page		201	f <u>2</u>
roject No																			
roject Name		Envi	ro-Che	m Superf	und Site				Sit	e Loca	etion			<u>UŞ 4</u>	21, 7	Zionsvi	lle, Ir	ndiana	<u>.</u>
urface Elevat	ion	883.8		Compl	letion Dept	th <u>31.</u>	O ft	bgs	Αu	ger Di	epth_	29	ft b	gs	Ro	tary De	pth _	ft	bgs
uadrangle	Rossto	n	s	ec	_ т	R.		·	Dat W-	e: Sta ter Le	ert	1/	30/9	8	_ Fir	ish	2/3	/98	···
TM (or State ane) Coord. I	N.(X)	92166	8.8	E.(Y)	72	<u>5903</u>	.5_		Dui	ing D	rilling	<u> </u>	.0 ft	bgs	_ At	Comple	etion	<u> </u>	ft bg
ititude 3										3	SAN	APL	ES				PER	SON	INE
oring Location	n <u>Sou</u>	thern Con	crete P	ad Excav	ation Ar	ea				1.							-	Steve	
rilling Equipme	ent and	Method <u>C</u>	ME-75			- Difd		Depth	Sample No.	ple Type	Semple	(ts1)	elue ws/6")	sture tent (%)	PID Reading (ppm)	Helper	٠.	Dave I Justin	
		RIPTION				ြင့်	او	C Cer	San	Semple	Series	ð	2 g	§ §	<u>5</u>		RE	MAF	RKS
PC	OORLY	GRADED S nedium der	AND m	edium to	coarse		\}			X	1		8 5						
, ,	L)			,, , , , , ,			į	- 21	14!	<u> </u>	13	NP		11	0.0			.*	•
	•						Į.	- - 22		IV			12						:
-861.8				•			ŧ	=		$ / \rangle$	j		9						
		Y with Sar	nd hard,	, gray, tra	ice			- 23 -	146	1	14	7.7 B	6 10	9	0.0	 .			
- 859.8	avel (CL	-1					涯	- - 24		IX			11 15						
							%			V	1	<u> </u>	18						
858.8							犯	- 25	147	1	17	7.3 B	·5		0.0			•	
857.8					•		*	- 26		IX			16 19						
050.0				•			犯	- 27		V	1				0.0				
856.8							差		148	$\mathbb{N}/$	18	10 S	16		0.0				
855.8							集	- 28		ľĂ			18 22						
854.8	Sand	lenses at 2	9 and 2	29.5 feet.			犯	- 29	149	$\langle - \rangle$	18	5.9	9		0.0				
							貄			\mathbb{V}			13 20						
853.8							差	30		$ \Lambda $			28		,				
852.8 Bor	ing term	ninated at 3	1 feet a	and tremm	nie		4	31											
8to	uted wit	th cement-b	entonit	e grout.												-			
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to Diff.EPAbels project Difference and an analysis de

	MC ENVIRONMENTAL RISK	MANAGEN	/ENT	Γ	Fiel	a B	oring	LO	9	Page 1	of <u>2</u>
Project	No. 3709.001 County				ng No.		G-8-	98	м	onitor Well No.	· <u></u>
1	Name Enviro-Chem Superfund Site										
Surfac	e Elevation 884.6 Completion Dep	th <u>24.0 ft</u>	<u>bgs</u>	Aug	er Dep	th	22 ft	bgs	Ro	otary Depth	ft bas
1	ngle Rosston SecT										
LITTM 16	or State			Wate	er Lew	el:					
4	Coord. N.(X) 921598.6 E.(Y) 72									Completion 1	1.0 ft bgs
	e 39° 57' Longitude 86°			$\overline{}$	S	AM	PLES	<u> </u>		PERS	SONNEL
Boring	Location Southern Concrete Pad Excavation A	rea				Sample Recovery (inches)					Steve Conway
Drilling	Equipment and Method <u>CME-75</u>	- [0]	•	Š.	Sample Type	Ę.	Op (tsf) N Value	٤ ١	g g	Driller - (Dave Ellis Justin
		Graphic Log	of part	Sample No.	eldr.	900	fag	Stur S	2 2	Helper -	
Elevation		5 2 6	3 &		Sar	S &	ဗီ z		_		MARKS
E	LEAN CLAY FILL with Sand soft to medium stiff, brown, trace roots and gravel (CL-FILL)			73	\ /	14	.4 1 B 1	1	0.0		
E883.6			, 1		ΧI		2	:			•
E					/ V		'				
E-882.€	3		2	74	7	- 1			0.9		
E 881.6			3		VΙ		B 1	- 1			
E	Gravel lens at 3.6 feet				/		2			 :	
880.6			4	75	\	16 3	1.1 2	12	3.0	-	
Ė.	(SC-FILL)		_	ĺ	VI		B 7	- 1			•
879.6			٦		M		7		1	,	
878.6	LEAN CLAY with Sand hard, brown and		6	210		21 4	.5 6	1 1 2	17.7		
F	gray mottled, trace gravel (CL)		ľ	۱۰۰۱)	$\sqrt{ }$		P 6		'''	·	•
877.6			7		XΙ		12			12" Steel Cas	ing installed
E 876.6			8	<u> </u>	__				1	to 7 feet.	
E	UW=144.3 pcf SG=2.766			1,1		24 3	.0 ST	13	NA		
875.6	Grades with Gravel.		9	•							
Ė		///									·
874.6		/// /////////////////////////////////	10 2	12	7	1 3	.0 5 5 5	11	4.5		•
873.6		₩ E 1	1	- [\	XI.	'	7			Bottom of Exc 873.8+/-	avation at
E							. 7				
872.6		<i>∭</i> _1	2 2	13	1/2	1 3.	0 3	11	3.5		
	Gravel lens at 12.4 feet	///Æ.	3	- \	/	, f	, 6	1.		*	
871.6 		<i>/////</i> E '	٦	-1/	$\backslash $		7				•
	LEAN CLAY stiff to very stiff, gray, trace	///E-1	4 2	14	1 2	0 2.	0 3	9	1.5		
=	sand and gravel (CL)	<i>////</i> /=		\mathbb{I}	$/\!\!\mid^2$	P	4		'''	·	
869.6		/// =1!	5	1/			5 9		·		
868.6		/// = 10	<u>.</u>	\bot	1_						
- 800.0		<i>////</i> /= ``	21	5	/ 2	1 1.7 P		11	1.5		
867.6		//// E−17	7	$ \rangle$			4				
				V	V		5				
866.6		/// = 18	21	6	2			11	1.5		
-865.6		// 19		$ \rangle$	/	P	3				
000.0				1/	\backslash		6				
- 1		////>	1	<u></u>	Y			LI	- 1		

Project No. 3709.001 County Boome Scring No. G-8-98 Monitor West No. Project Name Enviro-Chern Superfund Site Surface Elevation B84.6 Competion Depth 24.0 ft bags Control of Sites Street Elevation Street Street No. 921598.6 Ery 725695.7 Depth 23 ft bags No. 921598.7 Depth 23 ft bags No. 921598.7 Depth	We	1 N 1 PC ENVIRONMENTAL RISK MANAGEMEN	NT		Fiel	d B	orii	ng I	.og		Page _	2 of 2
Surface Elevation 884.6 Completion Depth 24.0 ft bgs Auger Depth 22 ft bgs Rotary Depth ft bgs Outedrangle Rosston Sec. T. R. Date: Start 1/30/98 Finish 2/5/98 Water Level: During Drilling 221.0 ft bgs At Completion \$\frac{1}{2}\) Latitude 39° 57' Longitude 86° 16' SAMPLES PERSONNEL Boring Location Southern Concrete Pad Excavation Area Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS DESCRIPTIO	Project No	. <u>3709.001</u> County <u>Boone</u>	_	Borin	ng No	۰	G-	8-9 <u>8</u>	<u> </u>	_ Mc	nitor Well	No
Surface Elevation 884.6 Completion Depth 24.0 ft bgs Auger Depth 22 ft bgs Rotary Depth ft bgs Cuedrangle Rosston Sec. T. R. Date: Start 1/30/98 Water Level: During Drilling Plane Coord. N.(X) 921598.6 E.(Y) 725895.7 Date: Start 1/30/98 Water Level: During Drilling Drilling Plane Coord. N.(X) 921598.6 E.(Y) 725895.7 Date: Start 1/30/98 Water Level: During Drilling Drilling Plane Coord. N.(X) 921598.6 E.(Y) 725895.7 Date: Start 1/30/98 Water Level: During Drilling Plane Date: Start 1/30/98 Date: Start 1/30/98 Water Level: During Drilling Plane Date: Start 1/30/98 Date: Start 1/30/	Project Na	meEnviro-Chem Superfund Site	_	Site I	Locat	tion			JS 4	21, Z	ionsville,	Indiana
UTM (or State Plane) Coord. N.IX] 921598.6 E.IY) 725895.7 During Drilling 221.0 ft bgs At Completion 1.0 ft bgs During Drilling 221.0 ft bgs At Completion 1.0 ft bgs During Drilling 221.0 ft bgs At Completion 1.0 ft bgs During Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs At Completion 1.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs At Completion 1.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs At Completion 1.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs At Completion 1.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs At Completion 1.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs At Completion 1.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs At Completion 1.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling 221.0 ft bgs Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS During Drilling Equipment and Method CME-75 Elevation Description Drilling Equipment and Method CME-75 Elevation Description Drilling Equipment and Method CME-75 Elevation Description Description Drilling Equipment and Method CME-75 Elevation Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Descriptio	Surface E	evation 884.6 Completion Depth 24.0 ft bg	<u>15</u>	Auge	r Del	pth _	_22	ft b	Q5	_ Ro	tary Depth	ft bgs
UTM (or State plane) Coord. N.(X) 921598.6 E.(Y) 725895.7 During Drilling V21.0 ft bgs At Completion V 1.0 ft bgs Person V21.0 ft bgs At Completion V 1.0 ft			_	Date:	Star	rt	1/3	30/9	8	_ Fin	ish2	/5/98
Boring Location Southern Concrete Pad Excavation Area Drilling Equipment and Method CME-75 Elevation DESCRIPTION OF MATERIALS DESCRIPTION OF MATERIALS Elevation DESCRIPTION OF MATERIALS DESCRIPTION OF MATERIALS Elevation DESCRIPTION OF MATERIALS Elevation DESCRIPTION OF MATERIALS LEAN CLAY stiff to very stiff, gray, trace sand and gravel (CL) 863.6 863.6 860.6 Boring terminated at 24 feet and tremmie grout.	UTM (or S Plane) Cod	tate rd. N.(X) 921598.6 E.(Y) 725895.7	_ '				<u>⊽21</u> .	0 ft	bgs	_ At	Completio	1.0 ft bgs
Elevation DESCRIPTION OF MATERIALS Elevation of Mat	Latitude_	39° 57' Longitude 86° 16'	-		S			ES			PE	RSONNEL
Elevation DESCRIPTION OF MATERIALS Elevation of Mat	Boring Loc	ation Southern Concrete Pad Excavation Area	-			ches					_	•
Elevation DESCRIP TION OF INTERNALS LEAN CLAY stiff to very stiff, gray, trace sand and gravel (CL) 862.6 POORLY GRADED SAND medium grained, dense, gray (SP) Boring terminated at 24 feet and tremmie grouted with cement-bentonite grout.	Drilling Eq	ipment and Method CME-75	8	No.	• Typ	- E	Ē	9,1	ure nt (%	o ding	Helper -	
Elevation DESCRIP TION OF INTERNALS LEAN CLAY stiff to very stiff, gray, trace sand and gravel (CL) 862.6 POORLY GRADED SAND medium grained, dense, gray (SP) Boring terminated at 24 feet and tremmle grouted with cement-bentonite grout.		TEODINION OF MATERIALS	100	Sampl	Sempl	Sampl	Op (ta	N Val	Moist	PIO R (mad)		FMARKS
sand and gravel (CL) 862.6 POORLY GRADED SAND medium grained, dense, gray (SP) Boring terminated at 24 feet and tremmle grouted with cement-bentonite grout.	Elevation	LEAN CLAY stiff to very stiff, gray, trace			7		1.0	4			•	LINAINS
POORLY GRADED SAND medium grained, dense, gray (SP) 861.6 Boring terminated at 24 feet and tremmle grouted with cement-bentonite grout.	263 6		21		X			12				•
dense, gray (SP)				ĺ	$/ \setminus$	·					-	
Boring terminated at 24 feet and tremmie grouted with cement-bentonite grout.	862.6	1001121 01	2	218	$\setminus /$	18	NP	ŀ	.9	0.5		•
Boring terminated at 24 feet and tremmie grouted with cement-bentonite grout.	861.6		3		X)				
grouted with cement-bentonite grout.	E		4	/	\triangle							•
	860.6	Boring terminated at 24 feet and tremme grouted with cement-bentonite grout.				٠						
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Ve	INTERNITORMENTAL RISK MA	ANAGE	MEN7	7	Fiel	d B	orir	ng L	.og		Page _ 2 _ of _ 2
Project No	. <u>3709.001</u> County Bo	one		Bori	ng No	·	G-9	9-9 8		_ Mo	nitor Well No.
	me Enviro-Chem Superfund Site										
	evation 884.4 Completion Depth										
Juadrangk	Rosston SecT.	R		Date	: Star	rt	1/2	2/98	3	_ Fini	ish <u>1/26/98</u>
	tete rd. N.(X) 921739,4 E.(Y) 725										
	39° 57' Longitude 86° 1								•		PERSONNEL
oring Loc	ation Southern Concrete Pad Excavation Are	8				thes)					Geologist - C. O'Neil
rilling Equ	ipment and Method CME-75	Q	<u> </u>	ું ફ	Sample Type	Ę. Ż			t (%)	PID Reading (ppm)	Driller - Dave Ellis Helper - Justin
		Graphic Log	Depth (feet bgs)	Sample No.	mpfe.	Sample Recovery	Op (tsf)	N Value (blows/6")	oistur	D Re	Helper -
evation	DESCRIPTION OF MATERIALS	ادق	ے م	34	S.	Ø €	$\overline{}$	ze 4	ຂັ ວັ	₹ \$	REMARKS
	POORLY GRADED SAND medium to coarse		= :		\mathbb{N}			4			· .
863.4	grained, loose to medium dense, gray, trace gravel (SP)		— 21 =	l	ľÅ		-	7			
62.4	gravei (SF)		- 22	35		12	NP	4			
	•		=	35	\mathbb{N}			8			
61.4	•		_ 23 _		ΙXΙ			9 10			.
ļ			- 24	L_	\angle		1.6				
60.4	Cc = 0.49		= -	36	N/I	14	NP	6 8			Grain Size Analysis
59.4	Cu = 7.8		_ 25		X			10 10			
			- 26		V		·				
58.4	•		- 26 -	37	\backslash	13	NP	6 8			
57.4	· · · · · · · · · · · · · · · · · · ·		_ 27		ΙXΙ			10 11	i		
		M E			VV			''			
56.4		E	- 28 -	38	1	13	NP	4			
55.4		K F	- 29		$ \chi $			10			
33.4		E			$/\backslash$			10			
54.4			- 30	39		14	NP	8			
		ŒΈ	- 31		M			12 12		İ	
53.4		E			\mathbb{N}			16		·	
2.4			- 32	40		17	NP	3			
İ		× E	- 33		VI			9 18			
1.4		₩ŧ			\bigwedge			21			
0.4		XX E	- 34	41	$\left\langle -\right\rangle$	19	NP	7	18		1
,	SILT medium dense, gray, trace gravel (SM)	TIE			$\backslash\!/ $	ĺ		11 13			
9.4) IF	- 35		Λl			14			·
8.4		LIF	- 36		}						
8.4	Boring terminated at 36 feet and tremmie grouted with cement-bentonite grout.					İ					
	giodica	.			-		.				
				İ			i				
	1			İ		ļ					
	ĺ		- 1						•		

We	PARE ENVIRONMENTAL RISK M.	ANAGEMENT	Γ .	rielo	1 RO	ring i	Log		Page	1 of 2
Project N	o. <u>3709.001</u> County <u>Bo</u>	oone	Bori	ng No.		3-10-9	8	_ Mo	nitor Well N	lo
Project N	Enviro-Chem Superfund Site		Site	Locati	on _		JS 4:	<u>21, Z</u>	ionsville, I	Indiana
Surface E	levation 883.8 Completion Depth	32.5 ft bgs	Aug	er Dep	th	31 ft t	9 08	_ Rot	tary Depth_	Justin ft bas
Quadrang	le Rosston Sec. T.	R								
UTM (or S Plane) Co	State ord. N.(X) 921668.0 E.(Y) 725	875.2	Durin	ng Drill	ling <u>∇1</u>	6.0 ft	bgs	_ At	Completion	▼ 0.1 ft bgs
_	39 57 Longitude 86*			S	AMP	LES			PEI	RSONNEL
Boring Lo	cation Southern Concrete Pad Excavation Are	8		.	ches		_	_	Geologist - Driller -	Steve Conway
Drilling Eq	uipment and Method <u>CME-75</u>	je r g	Sample No.	Sample Type	Semple Recovery (inches)	Op (tst) N Velue (blows/6")	\$ E	PID Reading (ppm)	Helper -	
	THE PROPERTY OF MATERIALS	Graphic Log (Depth	Sempl	Sampl	Sempl	N Vet	Moist	70 P	Helper -	EMARKS
Elevation	DESCRIPTION OF MATERIALS 13° CONCRETE over limestone subbase.	4.4.	+"	"	-		-		131	LIVIANICO
E			61		6 1	IP -	12	121		
882.8		13.4E	"	\mathbb{N}		" -				
881.8		A A E 2		ΙĂΙ		11	i			•
880.8	CLAYEY SAND FILL brown, trace brick and	13 15 E 3	62	(15 1	.0 5	17	139		• •
E	gravel (SC)			M	.	B 4	ŀ			
879.8				$ \Lambda $,	5				•
878.8	LEAN CLAY medium stiff, brown, black and	5	63	()		7 1	21	63		
E .	gray (CL)	E 6		$ \mathcal{V} $		B 3 2				•
E-877.8	Grades to brown.			\mathbb{N}		2				
876.8		7 F	125	1	- 1	.8 5 B 6	12	34	12" Steel (Casing installed
875.8		8		IXI		8				
H			<u></u>	$\angle \lambda$					Bottom of	Excavation at
874.8	SANDY CLAY dark brown (CL)		126		16	B5 ST	9	NA	874.8+/-	
873.8	W	10			•					
Ē		11	127		12 1	NP 3	10	6.0		
872.8	SAND medium to coarse grained, medium dense, trace clay (SP)		127		'- '	6 7		5.5		
871.8	LEAN CLAY with Sand very stiff, gray (CL)	12		A		6				
870.8		13	128	$\left(\cdot \right)$	13 3	.3 4	11	2.0		•
		 14		\bigvee		B 5 6				•
869.8				\bigwedge		6			·	•
868.8		15	129	(.0 2 B 4	10	5.0	1	
E		¥16		\mathbf{V}		5				
867.8				$/ \setminus$		6				
866.8	POORLY GRADED SAND medium to coarse	17	130	7	4 1	₹P -	1-	0	1	
865.8	grained, gray (SP)	E 18		XI		2	1			,
E		XE.		<u> </u>		2			<u> </u>	•
864.8		E 19	131	V	15 N	IP 2	•	0		•
		交通公 国	l.	V V	1	1	1	1	4	

We	HOLENVIRONMENTAL RISK M	ANAG	EMENT	7	Fiel	d B	nito	ıg L	.og		Page	2 of	2_
Project No	o3709.001 CountyBo	oone											
Project N	Enviro-Chem Superfund Site											Indiana	
Surface E	levation 883.8 Completion Depth	32.5	ft bgs	Aug	er Dep	oth	31	ft b	98	_ Rot	ary Depth	Justin ft	bas
Quadrang	ie Rosston Sec. T.			Date	: Star	t	1/2	8/98	3	_ Fini	sh2/	3/98	
	State ord. N.(X) 921668.0 E.(Y) 725				ng Dril	lling <u>Z</u>	716.	0 ft	bgs	_ At	Completion	▼ 0.1 f	t bas
	39° 57' Longitude 86°				S	AM	PLI	S			PE	RSONN	EL
Boring Lo	sation Southern Concrete Pad Excavation Are	8				Ches			_		Geologist Driller -	 Steve Cor Dave Ellis 	
Drilling Eq	uipment and Method <u>CME-75</u>	Ş	الم الم	Š.	e Type	رة م	Į,	ue s/8")	Moisture Content (%)	PID Reading (ppm)	Helper - Helper -		
	TOTAL OF MATERIAL C	Graphic Log	Depth (feet bgs)	Semple No.	Sample	Sample Recovery	Op (tsf)	N Val (blow	Moist	PID R (ppm)		EMARK	$\frac{1}{2}$
Elevation	DESCRIPTION OF MATERIALS POORLY GRADED SAND medium to coarse		=	-				5					
E	grained, gray (SP)		上 ₂₁	132	$\langle \cdot \rangle$	13	NP	3	-	0		•	
-862.8 -			E	l	V			5					
861.8			E 22		$ \Lambda $			8				•	
860.8			<u> </u>	133	$\left\langle \cdot \cdot \right\rangle$	16	NP	6	-	0			
			E 24		V			8 10					
859.8 			E		$/\backslash$			9					
858.8			E 25	134		7	NP	5 8	-	0		•	
857.8			26		IX			7					
E			E ,,		$/\setminus$								
856.8	l · · · · · · · · · · · · · · · · · · ·		E '	135	Λ	12	NP	8 13	-	0			
855.8			28 		X			13 19					
E			_ _ 29	136		14	NP	8	-	0			
854.8			E		\bigvee	••		20 13					
853.8			<u> </u>		$ \Lambda $			18					
852.8	SILTY SAND to FINE SAND medium dense,		31		(\cdot)		NP	-	-	-			
E	gray (SM/SP)		_ 32		X								
851.8	Boring terminated at 32.5 feet and tremmle		=			,					1 '	fusel at 32	.5
1 1	grouted with cement-bentonite grout.	1.									feet.		•
													•
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Me	NO ENVIRONMENTAL RISK MA	NAGE	MENT	, 1	Field	d Bo	orin	g L	og		Page _ 1 _ of _ 2
	37.09.001 County Bo	one		Borir	Boring No. G-11-98 Monitor Well No.					nitor Well No.	
	Enviro-Chem Superfund Site			Site	Locati	ion _			3 42	ا کرا	onsville, indiana
_		36.0 f	t bgs	Auge	r Dep	th	34	π og	8	Rot	ary Depth <u>Tt bgs</u>
Surrace	de Rosston Sec T	_ R		Date: Start 1/22/98 Finish 1/27/98 Water Level: 720.0 ft has At Completion 7 ft has						sh <u>1/27/98</u>	
UTM (or State Plane) Coord. N.(X) 921739.6 E.(Y) 725846.6						ei: Jing <u>Y</u>	20.0) ft b	ogs	_ At	Completion <u>T</u> ft bas
Plane, Co	39° 57' Longitude 86° 1	<u>6 '</u>			S	ĀM	PLE	S			PERSONNEL
Latitude_	cation Southern Concrete Pad Excavation Area					8					Geologist - Steve Conway
	uipment and Method <u>CME-75</u>			- કું	Туре	y (inc			. £	PID Reading (ppm)	Driller - Dave Ellis Helper - Justin
Drining Co		Graphic Log	Depth (feet bgs)	Sample No.	-ldm	Sample Recovery	ts)	Value fows/	olstu	D Res	Helper -
Elevation	DESCRIPTION OF MATERIALS			8	Š	υς 6	Ŏ NA	z e -		000 t	
=	10" Concrete floor slab over 14" Crushed limestone subbase	44	E		\bigvee			4			
883.6		0.0	F1		Λ		ı	11			·
882.6	CUL wish Conductor wild	4.4.	E 2	5	$\left(\cdot \right)$	10	3.5	4	12	31.9	
E 882.8	LEAN CLAY FILL with Sand very stiff, brown and gray mottled (CL-FILL)		₹ ,		V		P	5 6			
881.6			E		$ \Lambda $			9		·	
880.6	LEAN CLAY stiff to very stiff, gray, trace		4	6	$\left\langle \cdot \cdot \right\rangle$	17	2.0		10	24.5	
E	sand and gravel (CL)		E,		IVI	•	P	6			
879.6					$ \Lambda $			9			
878.6			6	42		13	1.7	4	11	74.8	1 .
<u> </u>			E,		$ \mathbf{V} $		В	2			Steel Casing installed to 7 feet.
877.6	·		E		$/\backslash$		•	5			
876.6			E 8	43		23	2.9 B	3	11	5.0	Bottom of Excavation at 876.6+/-
IE .			<u> </u>		Χ			7 2			
875.6			Ē.,		$V \setminus$			_			
874.6	UW=145.1 pcf SG=2.70		F 10	44		17	2.8 B	ST	12	NA	
E			E 11						٠	ŀ	
873.6			Ε.,						<u> </u>		
872.6			12	45	\backslash	24	1.3 P	3	11	3.4	
E 871.6			_ 13		X			5 6			
E			<u> </u>		\triangle				_		
870.6	·		= '~	46	$\backslash /$	24	1.9 B	3	11	3.4	
869.6	·		<u> </u>		Х	-		5 6			
E					\triangle		1 =	-	11	2.9	
868.6			= '3	47	$\setminus /$	23	1.5 B	2 2	' '	2.9	
867.6			_ 17 _		X			3			
E	Sand lens at 17.5 feet		- - - 18		\triangle		<u> </u>	ļ.	12	2.9	4
866.6	LEAN CLAY with Sand to SANDY CLAY		= '3	48	$\setminus /$	20	1.4 B	2	13	2.8	
865.6	stiff, gray (CL)		<u>-</u> 19		X			5			:
F			<u>-</u>		/ N	1	1	1	1		

We	INC. ENVIRONMENTAL RISK MA	ANAGEMENT	. 1	Field	d B	orin	ıg L	.og		Page	2 of2_	
Project No	3709.001 County Bo	one	Borin	ıg No.	·	G-1	1-98	В	_ Mo	nitor Well N	o	
Project Na	me Enviro-Chem Superfund Site	·	Site LocationUS 4			<u> 15 4:</u>	21, Zionsville, Indiana					
Surface Fl	evation 884.6 Completion Depth	36.0 ft bgs	Auger Depth			34 ft bgs			_ Rot	Rotary Depth <u>ft bgs</u>		
Ouadrangle Rosston Sec T R UTM (or State				: Stan	t	1/2	2/98	<u> </u>	_ Fini	ish <u>1/2</u>	7/98	
UTM (or S	tate ord. N.(X) 921739.6 E.(Y) 725	846.6	Wate Durin	r Lev ig Dril	el: Iling <u>3</u>	220.	0 ft	bgs_	_ At	Completion	▼ ft bgs	
	39° 57' Longitude 86° 1			S	AM	PLI	ES			PEF	RSONNEL	
	ation Southern Concrete Pad Excavation Area				Semple Recovery (inches)					•	Steve Conway	
	sipment and Method <u>CME-75</u>	0 2	ě	Sample Type	ry (in		(.9/	Moisture Content (%)	PID Reading (ppm)	Driller - Helper -	Dave Ellis Justin	
· ·		Graphic Log Depth	Sample No.	-idma	emple ecove	Op (tsf)	Valu	loistu	0 Re (mg/	Helper -		
Elevation	DESCRIPTION OF MATERIALS	2 0 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	49	Š	5	O NP	2 £	≥ 0	3.9	R	EMARKS	
=	POORLY GRADED SAND medium to coarse grained, medium dense, gray, trace gravel			$ \backslash $			18"	•				
863.6	(SP)	E 21		Μ								
E		E 22	50		12	NP	3		6.0	·	. :	
E-862.6		ME.		$ \backslash $, _		6			İ		
861.6		23	:	M			8					
E		建 24	51	$\langle \rangle$	15	NP	3	-	8.2		•	
860.6	•	ME.	"	\mathbb{N}			5					
859.6		E 25		ΙĂΙ			7				•	
		£ 26	52		13	NP	4	<u> </u>	10.3	Grain Size	Analysis	
858.6	Cc=9.0 Cu=8.0	₩ E	52	\mathbb{N}	13	""	8				7111017010	
857.6		E 27		ΙXΙ			9					
Εĺ		E 28	53		15	NP	6	-	2.9	4		
856.6		SE .	53	$\backslash / $	15	"	10					
855.6		E 29		١X١			15 20					
Εl		€ 30		\triangle	14	NP	8	_	2.9	4		
854.6 			54	\mathbb{N}/\mathbb{I}	"	'*	11	١				
853.6		31		ΙXΙ			16 18					
853.6 		32		\angle	-	NP	<u> </u>	 	1.8	4		
852.6	Grades to dense	XE I	55	\mathbb{N}	18	INP	7 13		1.8			
851.6		33		X			20 36				•	
		Œ 34		igspace								
850.6		XE 1	56	Λ	14	NP	6 14	-	3.4			
849.6		35		$ \chi $			21 24					
		Æ.		/					<u>.</u>			
- 848.6	Boring terminated at 36 feet and tremmie	36					_				•	
	grouted cement-bentonite grout.											
						Ì						
	·											
						ŀ						

MA	Na inc. environmental risk ma	Field Boring Log Page 1 of 2										
	2709 001 County Boo	ne	Boring No. G-12-98 Monitor Well No.						itor Well No			
	Enviro-Chem Superfund Site		Site I	_ocati	on _		- 00	72	421, Zionsville, Indiana			
	. 884.0 Completion Depth	36.0 ft bgs	Auger Depth_			34 n ogs			Hote	Hotary Depth 11 Dos		
	Deceton Sec. T.	_ R	Date: Start 1/28/98 Finish 2/1/98 Water Level: During Drilling ▼20.0 ft bgs At Completion ▼ ft bg						sh <u>2/1/98</u>			
Quadrangk	e Hossion sate rd. N.(X) 921671.0 E.(Y) 7258	842,4	Wate Durin	r Levi g Drill	el: ling <u>V</u>	20.0	ft b	gs	At (Completion <u>Y</u> ft bas		
Plane) Coo	Latitude 39 57 Longitude 86 16						S			PERSONNEL		
Boring Loc	ation Southern Concrete Pad Excavation Area)			(Inches)					Geologist - C. O'Neil		
	ipment and Method CME-75			Sample Type	(jy			<u> </u>	PID Reading (ppm)	Driller - Dave Ellis Helper - Justin		
Dinning Edu		Graphic Log Depth	Semple No.	elg E	Sample Recovery (Op (tsf)	(blows/6")	orten	E E	Helper -		
Elevation	DESCRIPTION OF MATERIALS		57	, w	% æ 15		z <u>e</u> :		₹ S			
E	7" CONCRETE over limestone FILL subbase.	4 A E		\mathbb{N}	``	1	27					
883.0		1 A E		X								
E	LEAN CLAY FILL with Sand stiff to very	2	1	$\langle - \rangle$	20	3.7	6	10	912			
882.0	stiff, brown and gray, trace gravel and brick		56	$ \backslash / $	-	В	5.					
881.0	fragments (CL-FILL)	3 3 m		ΙX			6		l			
E		//// = 4	59	$\langle \cdot \rangle$	-		_	-				
880.0			28	$\setminus /$								
879.0		//// 5		X								
E		6		$\langle \cdot \rangle$	24	1.2	3	9	0.8	-		
878.0	LEAN CLAY stiff to very stiff, gray, trace sand and gravel (CL)		60	\mathbb{N}	-	В	3	-				
877.0	Salin and Area	/// /////////////////////////////////		ΙX			5 7			12" Steel Casing installed to 7 feet.		
E		# 8		$\langle \cdot \rangle$	17	3.0	1	10	1.1			
876.0	•	<i>\\\\</i>	82	$\mathbb{N}/$	[''	B.0	3		'''			
E 875.0		## 9		X			5			Bottom of Excavation at 875.1 +/-		
E		E 10	83	$\langle \cdot \rangle$	18	2.6	4	11	0.5			
874.0			83	\mathbb{N}		B B	5					
873.0	•	*** 11	'	IX			9					
E		E 12	باٍٰٰ	V	1	1 -	2	11	-	-		
872.0	•		84	N/	18	1.7 B	4		"			
E _{871.0}	•	13	3	IX			10					
E	•	// /		V	1		_		-	4		
870.0	SILTY SAND to fine SAND medium dense,	MIE '	85	N/	14	NP	8	13	"			
869.0	gray (SM/SP)	15	5	ΙX			10 8					
E		洲非. .		<u> </u>	_					_		
868.0	LEAN CLAY with Sand very stiff, gray (CL)	10	86	1	18	3.1 B	6 4	10	°			
E		/// E 17	7	X			4					
-867.0 -	·			V	1					·		
866.0		# 18	87	1	17	3.3 B	2	10	0			
E		/// € 19		IX		"	4					
865.0				\mathbb{N}	1		6					

MA	Nal inc environmental risk ma	NAGEMENT	T	-ield						•	<u>2</u> 01 <u>4</u>		
	Bor	nne	Borin	g No.		<u>G-12</u>	2-98		Monitor Well No.				
	Enviro-Chem Superfund Site		Site	ocatio	on _		U:	5 42	<u>1, Zi</u>	<u>onsville, l</u>	ndiana		
	COMpletion Depth	36.0 ft bgs	Auger Depth			٠							
Surface Ele	Rosston Sec. T.	_ R	Date	Start		1/20/30				Finish <u>2/1/98</u>			
Quadrangk UTM (or St	ate rd. N.(X) 921671.0 E.(Y) 7258	342.4	Wate Durin	r Leve ig Drilli	ı: ng <u>¥</u>	20.0	ft b	gs_	At	Completion	<u>▼ ft br</u>	<u> 28</u>	
Plane) Coo	39° 57' Longitude 86° 1	6		5/	M	PLE	S			PEI	RSONNE	ĒL	
Latitude	39° 5/ Longitude 39			Г	3	Ī					C. O'Neil	-	
	stion Southern Concrete Pad Excavation Area] ,	ě	돌		اہ	38	o i	Driller - Helper -	Dave Ellis Justin	•:	
Drilling Equ	ipment and Method <u>CME-75</u>	Graphic Log Depth	Semple No.	Sample Type	Sample Recovery (Op (tsf)	N Value (blows/6")	Moisture Content (PID Read (ppm)	Helper -	·		
	TOTAL OF MATERIALS	Grag Gep Gep	Sem	Sam	Rec	8	2 8	\$ 5	5 g	RI	EMARK!	<u>s</u>	
Elevation	DESCRIPTION OF MATERIALS SAND medium to coarse grained, loose to	SSE T	88	1	18	NP	1 2	17	. 0				
E	medium dense, gray (SP)	上21		ΙXΙ			5]			
863.0				/	.		1					•	
862.0	•	22	89	1	12	1.2 B	2 2	14	0	1	•		
E	LEAN CLAY stiff, gray, trace sand (CL)			ΙVΙ		•	4						
861.0		//// * **		/			5						
860.0		24	90	()	13	0.8	1		0	† '			
- 860.0				IVI		8	2		ŀ	ļ			
859.0			'	$ \Lambda $. 4						
	SAND medium to coarse grained, loose to medium dense, gray (SP)	E 20	91	$\left\langle \cdot \right\rangle$	12	NP	4	-	0	┥ .	• •		
858.0	medium delise, g.d, (a.,	ŒΈ.		IVI			9						
857.0		E 27	'	M			9				•		
E		E 28	92	$\left(\cdot \right)$	20	NP	2	-	6	-			
856.0		E .	١.	V			8						
855.0		E 25	9	$ \Lambda $			14						
		₩E 30	93	$\langle - \rangle$	21	NP	6	┨	-		•		
854.0		E		$ \rangle $			12 14	1					
E _{853.0}		E3	1	$ \Lambda $			19		1				
854.0 - 853.0 - 852.0		美 主 3:	2 94	$\langle \cdot \rangle$	15	NP	4	┼	10	\dashv	•		
852.0		₩ E	34	\mathbb{N}	.	"	9						
E _{851.0}		₽ 3:	3	ΙX			9 16	1.		1		•	
E			<u>.</u>	V		<u> </u>	<u> </u>	-	1-	_			
E 850.0		ME.	95	1/	13	NP	7 9		0				
E		₩E 31	5	X			13						
E-849.0				$V \setminus$									
E 848.0	Boring terminated at 36 feet and tremmie	30											
	grouted with cement-bentonite grout.												
								1					
	•					-					•		
	•		1						1.				
	·							1	-				

	MA	NO INC ENVIRONMENTAL RISK MA	NAGEMENT	•	ield					•	of <u>2</u>	
		Bot Savetu Bot	nne	Borin	9 No	G.	15-98	3	. Mor	Monitor Well No.		
ı		Enviro Chem Superfund Site		Site	.00811011							
		Completion Depth	24.0 ft bas	Auger Depth				22 14 Dago				
1		Con T	R	Date:	Date: Start 2/11/98 Finish 2/13/98 Water Level: During Drilling V21.5 ft bgs At Completion V					700		
	Quadrangle	Rosston Sec	BO2.2	Wate Durin	r Level: g Drillin	o <u>V2</u>	1.5 ft	bas	_ At (Completion ;	y ft bgs	
	Plane) Coor	d. N.(X) 921/39.9 E.(1) 725	6.		<u> </u>	MAD	LES			PFR	SONNEL	
l	Latitude	39° 57' Longitude 86° 1	<u>~</u>	-	SA T	8 INIL					Steve Conway	
		ation Southern Concrete Pad Excavation Area		ا ا		in Ch	_	<u>\$</u>	٤	Driller -	Dave Ellis	
	Drilling Equ	ipment and Method <u>CME-75</u>	ا ا ا ا ا ا ا ا ا ا ا ا ا ا ا ا ا ا ا	Semple No	Sample Type	2 5	2 8	Moisture Content (PID Reading (ppm)	Helper - Helper -	Justin .	
١		OF MATERIAL C	Graphic Log Depth	Semp	Same	Recovery (N Value (blows/6")	Con	014 (99)	RE	MARKS	
l	Elevation	DESCRIPTION OF MATERIALS LEAN CLAY with Sand hard, brown, trace		229		4 4.5	+ 2	11	173		,	
	E	gravel (CL)	** 1		$ \chi $		5					
	883.6			1	/		9				•	
	882.6	·	2 ²	230	 	- ' '	5 4	12	342	1 .		
	E		W/E 3		ΙVΙ		7				•	
	881.6						8					
	880.6	·	4	231	 		.5 4 P 7	11	50	1		
	E		/// E 5		V		10					
	879.6						6			· .		
	878.6	LEAN CLAY with Sand gray, trace gravel	6	247	()	17 3	.0 4	11		1		
	E // [(CL)	/// E 7		V		5			12" Steel G	Casing installed	
	877.6						6			to 7 feet.		
	876.6		8	248	()	19 2	1.1 3	11		1 .		
	E"				V		5		1			
	875.6				/		5					
	874.6	SANDY SILTY CLAY gray, trace gravel	19	249		24	.2 S	12	NP	LL = 17, Pl		
	E" [(CL-ML)	E 1	,						29% Silt		
	873.6	UW=144.8 pcf SG=2.73	ME '							21% Clay		
	872.6	Sand lenses at 11.5 and 11.8 feet	1:	2 250	╁╇╁	20	1.3	. 1	+	1		
	E"."	•	1:	3	V	`					•	
	871.6	40.54	WE!		$ \Lambda $		5	·				
	E	Sand lens at 13.5 feet.	1	4 251	$\left\langle \cdot \right\rangle$	21	1.7		1	1		
	—870.6 —			_	V			- 1				
	869.6		1		$ \Lambda $!	;				
	<u> </u>	Sand lens at 15.9 feet.	1	6 252	()	19	1.7	2	+	┥		
	868.6			- } -	V		1	3 .				
	867.6		1	1	$ \Lambda $		- 1	۱ ا				
project IO:(Vertex project no:(Vert	E		1	B 253	(-)	24	1.7	+	+	-		
	866.6	SANDY CLAY stiff, gray, trace gravel						1 2				
	865.6	(CL-SC)	1	9	$ \Lambda $			2				
PROPERTY AND EASTER	 	Sand lens at 19.5 feet.			<u> </u>	1					· 	
2	<u> Г</u>	VERSAR, INC.; 200 W. 22nd Street	; Suite 250;	Lom	bard, I	L 60	148; (30/2	68-8		<u> </u>	

ternelete 10:ILEPAlgint project 10:IVorser project next/nun date:3/6/98

						()	
Boring terminated at 24 feet and tremmie grouted with cement-bentonite grout.	862.6 (SC)	gray, t	٦I	Boring Location Southern Concrete Pad Excavation Area Drilling Equipment and Method CME-75	Letitude 39° 57' Longitude 86°	Ousdrangle Rosston Sec. T. UTM (or State 921739.9 E.(Y)	tion 884.6	Project No. 3709.001 County E	TOIN WILL ENVIRONMENTAL RISK MANAGEMENT
			Gra Log	phic	16:	725802.2	Completion Depth 24.0 ft bgs	Boone	K MANAGEMENT
	255	254	San	nple No.	SA	Water Level: During Drilling \$\frac{\frac	Auger Depth	Boring No	
	22 22 29	21 1.2	Red Op	overy (inche (tsf) /alue	SAMPLES	o <u>∇21.5</u>		G-15-98	Roa Runda Diala
	IO		Mo Co	ows/6") isture ntent (%)	S	ft bgs	22 ft bgs	-98 US 42	
			PID (pp	Reading m)		<u>}</u>	R S	1, Zi	
			REMARKS	Driller - Dave Ellis Helper - Justin Helper - Justin	PERSONNEL	omp	ary Depthft bgs	0S 421, Zionsville, Indiana	·

	:				F	ield	Во	ring	y Lo	g	F	Page1 of2		
	VC	NO INC. ENVIRONMENTAL RISK MA	NAGEM	EN I	n • •	. Ma		3-16	-98	•	Mon	itor Well No		
	Project No.	3709.001 County Boo	ne		Boring	NO		<u>, 10</u>	US	42	1, Zic	onsville, Indiana		
		m t Olivin Comentum Site		•	5/(¢ 2000									
	Surface Fle	vation 884.8 Completion Depth	24.0 10	nns ,	Auger Dopin						Finish 2/13/98			
l		;	Date:	Stair-			,,			Completion <u>Y</u> ft bas				
	UTM (or St	921672.8 E.(Y) 7258	303.5							—— Ha				
1	ıin.ı.da	39° 57' Longitude 86° 1	<u>6 '</u>			SA	M	PLE	<u>S</u> _			PERSONNEL		
١	Boring Loca	stion Southern Concrete Pad Excavation Area					ches			=	- 1	Geologist - Chris White Driller - Dave Ellis		
ļ		ipment and Method <u>CME-75</u>	ဋ		Š	Sample Type	Recovery (inches)	Op (tsf)	9 8	5 2	ă I	Helper - Justin		
١			Graphic Log	Depth (feet bgs)	Semple No.	joure	N O	5	2 d	Conte	5 mg	REMARKS		
ł	Elevation		XXXX	<u> </u>	ە 225	~ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	15	2.25	16	12	0.0	11211111111		
		Crushed Limestone FILL subbase				VI		P	9			•		
	883.8			- 1		M		į	4					
	E	LEAN CLAY with Sand stiff, brown to		- 2	226	$\left\langle \cdot \right\rangle$	14	1.65		17	134			
ļ	882.8	brown and gray, trace gravel and organics (CL FILL)		_ 2		$ \bigvee $			2 4			•		
	881.8	100.		- J		$ \Lambda $			4					
	E			- 4	227	 	17	1.0 P	2	17	1500			
	880.8			- 5		V		P	3					
١	879.8			= -		/			3	i				
	878.8			- 6	228		18	NP	2 2	20	7.0	1		
	E			- - 7		ΙXΙ			3			12" Steel Casing installed		
'	877.8	CLAYEY SAND FILL loose, brown and gray, saturated (SC-FILL)				VV				<u> </u>		to 7 feet.		
	876.8	CUTY CLAY with Sand medium		- 8	256		24	0.9	ST	12	NA	LL = 20, Pl = 5 47% Sand		
	1111	self to stiff, brown and gray mottled, trace		_ 9								31% Silt 20% Clay		
	E-875.8	sand and gravel (CL-ML) Sand and gravel (CL-ML) UW = 139.9 pcf SG = 2.63 Sand lenses at 8.5 and 9.5 feet.		-						<u> </u>				
	E 874.8	Sand lenses at 8.5 and 3.5 test. LEAN CLAY with Sand very stiff, gray, trace		_ 10 _	257	1/	17	2.9	3	111	3.3			
		gravel (CL)		<u>-</u> 11		I X			5 7					
	873.8]	$V \setminus$								
	872.8			_ 12 _	258	1	15	2.3	3	12	1.4			
	lE I			_ _ 13		X	`		4 6					
	871.8	Sand lens at 13.5 feet.		=		<u>/</u> /				1_	1_			
	870.8			14 	259	1/	19	2.1	3	111	1.			
SAME.	IE !			_ _ 15		ΙX			4					
ACANA date: 3/6/96	869.8			=		1				_				
et ne:	868.8	SANDY CLAY stiff to very stiff, trace gravel		16 	260	1	16	2.9	5 3 3		4.	3		
-	IE .	(CL-SC)		<u> </u>	·	1 X			4 5					
DAVer	867.8			- - -		V.						_		
D: L. EP Algini project D: Nerse	866.8	POORLY GRADED SAND fine to medium		¥18 -	26	'\ /	21	NI	P 2	- 1	1 1	.4		
) <u> </u>	ΙĒ	grained (SP)		_ _ 19	,	X			3	- 1				
is Diff	865.8			=		<u>V</u>		$oldsymbol{ol}}}}}}}}}}}}}}}}}}$	L					
) a de la constant de	E	VERSAR, INC.: 200 W. 22nd Street	; Sulte	250;	Lom	bard,	IL E	014	8; 6	30/2	68-8	666		

Ve	NO INC. ENVIRONMENTAL RISK MANAGEMEN	Field Boring Log Page 2 of 2
Project No		Boring No. <u>G-16-98</u> Monitor Well No.
Project No	me Enviro-Chem Superfund Site	Site Location US 421, Zionsville, Indiana
Surface E	levation 884.8 Completion Depth 24.0 ft bgs	as Auger Depth 22 ft bgs Rotary Depth ft bgs
	le Rosston Sec. T. R.	
UTM (or S Plane) Cod	ord. N.(X) 921672.8 E.(Y) 725803.5	During Drilling <u>▼18.0 ft bqs</u> At Completion <u>▼ ft bqs</u>
_	39° 57' Longitude 86° 16'	
Boring Loc	ation Southern Concrete Pad Excavation Area	Geologist - Chris White Driller - Dave Ellis
Drilling Eq	uipment and Method CME-75	Sample No. Sample No.
=======	Uipment and Method CME-75	Sample No. Sample No. Sample No. Sample No. Sample No. Sample No. Sample No. Sample No. Sample No. Helbeu -
Elevation	DESCRIPTION OF MATERIALS	262 19 NP 2 0.4
E	grained gray, trace grayel (SP)	21
₩ 863.8	l	
862.8	l E	22 263 24 NP 1 - 2.4
E 861.8	<u> </u>	23
111	<u> </u>	24
860.8	Boring terminated at 24 feet and tremmie grouted with cement-bentonite grout.	
	·	
1. 1		

DRILL LOG

PROJECT ENVIRO-CHEM		OWNER		SKETCH MAP
LOCATION ZIONSVILLE, II	LOCATION ZIONSVILLE, IN W.O. NUM		2495-1010	ND - NOT DETECTED
BORING NUMBER IW-1	BORING NUMBER IW-1 TOTAL DEPT		DIAMETER 8.0'	VPPM - VAPOR PARTS PER MILLION
SURFACE ELEV	JRFACE ELEV WAT LEV: INIT		24-HRS	SS - SPLIT SPOON F - FINE M - MEDIUM
SCREEN: DIA 4"	LENGTH 5	3.	SLOT SIZE .020	C - COARSE
CASING: DIA 4"	LENGTH	11'	TYPE PVC	
DRILLING COMPANY TOP FLIGHT		DRITILLING ME	THOD HSA	
DRILLER NICK LOG BY VFB		DATE DRILLED 3-12-98	NOTES	

Depth (feet)	Graphic Log	Well Construction	Sample Number	Blow Count/ RQD/ % REC.	PID READINGS (VPPM)	DESCRIPTION / SOIL CLASSIFICATION((COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READINGS)
1						0.610 GREY AND BROWN CLAY,
2				· · · · · · · · · · · · · · · · · · ·		LITTLE SILT, TRACE FINE
3					80	TO COARSE SAND, WET,
4						DISTURBED, ODOR PRESENT
5 6			SS-18	8-15	54	6.0-9.8 GREY CLAY, SOME SILT, TRACE
7		·		17-32		F-M SAND, TRACE F-M
8			SS-19	9-10	12.5	GRAVEL (WELL ROUNDED), DAMP,
9				13-22		MOTTLED, SLIGHT ODOR
10			SS-20	5-5	20.4	9.8-10.0 BROWN F-M GRAVEL, SATURATED,
11				7-12		SLIGHT ODOR (CHLORINATED SOLVENT)
12	}		SS-21	3-5	3.0	10.0-12.0 GREY CLAY, SOME SILT,
13]			12-23		MOIST, NO ODOR
14]		SS-22	6-8	114.7	12.0-12.2 BROWN FINE TO MEDIUM
15		;		11-12	ND	SAND AND GRAVEL, SATURATED,
16			SS-23	3-4	ND	ODOR (CHLORINATED SOLVENT)
17				7-10		12.2-14.0 GREY CLAY, LITTLE SILT,
18		;	SS-24	4-5	ND	DAMP, NO ODOR
19				7-9		14.0-14.8 BROWN COARSE SAND, STRONG ODOR
20			SS-25	4-6	ND	(CHLORINATED SOLVENT)
21				9-9		14.8-19.5 GREY CLAY, LITTLE SILT,
22						DAMP. NO ODOR
						19.5-19.6 BROWN FINE SAND, SATURATED, NO ODOR 19.6-22.0 GREY CLAY, TRACE SILT, DAMP, NO ODOR

DRILL LOG

ROJECT ENVIRO-CHE	A OWNER -		SKETCH MAP					
LOCATION ZIONSVILLE,	N W.O. NUMBE	R 2495-1010	ND - NOT DETECTED					
BORING NUMBER IW -4	TOTAL DEPTH 28.00°	DIAMETER 8"	VPPM - VAPOR PARTS PER MILLION					
SURFACE ELEV	WAT LEV: INIT	24-HRS	SS - SPLIT SPOON					
SCREEN: DIA 4"	LENGTH 10'	SLOT SIZE .020	F - FINE M - MEDIUM					
CASING: DIA 4"	LENGTH 17'	TYPE PVC	C - COARSE					
DRILLING COMPANY TOP	FLIGHT DRITILLING ME	THOD HSA						
DRILLER NICK	LOG BY VFB	DATE DRILLED 3/16/98	NOTES					

Depth (feet)	Graphic Log	Construction	Sample Number	Blow Count/ RQD/ % REC.	PID READINGS (VPPM)	DESCRIPTION / SOIL CLASSIFICATION((COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READINGS)
						0 - 7.0 GREY BROWN CLAY, LITTLE
		1				TO TRACE SILT, TRACE FINE
2					110	TO COARSE SAND, WET.
3	٠					DISTURBED, ODOR PRESENT
4						
5			55-43	8-11	-6	7.0 - 10.0 GREY CLAY, SOME SILT,
6				12-12		TRACE FINE SAND, TRACE
]	SS-44	10-11		. M-C GRAVEL, DAMP, NO ODOR
				14-16		
9			SS-45	6-7	- 41	10.0 - 10.2 BROWN M-C SAND, SATURATED.,
10				8-14		NO ODOR
			SS-46	11-12	11	10.2 - 11.8 GREY CLAY, SOME SILT,
12				12-15		TRACE F-C SAND, DAMP, NO ODOR
13			SS-47	6-8	34	11.8 - 12.4 BROWN MEDIUM SAND, SATURATED.
14				12-14		NO ODOR
15			SS-48	5-4	15	12.4 - 13.8 GREY CLAY, SOME SILT, TRACE FINE
16				12-12		SAND, DAMP, NO ODOR
		ľ	55-49	10-11	15.7,	13.8-14.4 BROWN MEDIUM SAND, SATURATED,
18				12-18		SLIGHT ODOR
19		T T	SS-50	9-10	3.5	14.4 - 15.2 GREY AND BROWN CLAY AND
20	İ			10-11		SILT, TRACE F-C SAND/GRAVEL, DAMP
21		<u> </u>	SS-51	3-4	13	15.2-15.6 BROWN MEDIUM SAND, SATURATED.
22	İ		23-21	7-12		NO ODOR
23	- 1		1	/-12		

DRILL LOG - IW 4 (continued)

PRO JECT ENVIRO-CHEM	ow	NER		SKETCH MAP			
PROJECT ENVIRO-CHEM LOCATION ZIONSVILLE, IN	. w.o	W.O. NUMBER 2495-1010		ND - NOT DETECTED			
	TOTAL DEPTH 28	8.00"	DIAMETER 8"	VPPM - VAPOR PARTS PER MILLION			
BORING NUMBER IW -4	WAT LEV: INIT		24-HR\$	SS - SPLIT SPOON			
SURFACE ELEV	LENGTH 10'		SLOT SIZE .020	F - FINE M - MEDIUM			
SCHEEK. SI	LENGTH 17'		TYPE PVC	C - COARSE			
CASING: DIA	IGHT DRIT	TILLING MET	HOD HSA				
DRILLING COMPANY TOP FL	LOG BY VFB		DATE DRILLED 3/16/98	NOTES			
DRILLER NICK							

Depth (feet)	Graphic Log	Well Construction	Sample Number	Blow Count/ RQD/ % REC.	PID READINGS (VPPM)	DESCRIPTION / SOIL CLASSIFICATION((GOLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READINGS)
	l		SS-52	3-6	3	15.6 - 17.8 GREY CLAY AND SILT,
24				10-10		TRACE F-C SAND/GRAVEL, DAMP,
25			SS-63	6-13	1	NO ODOR
26			20.00	15-21		17.8 - 21.0 BROWN POORLY SORTED
27						SAND, SATURATED, ODOR
28						PRESENT
						21.0 - 25.0 GREY CLAY, LITTLE SILT,
						DAMP. SLIGHT ODOR
		}				25.0 - 25.3 BROWN SAND, SATURATED,
	ļ.	 				NO ODOR
		ļ.				25.3 - 27.0 GREY CLAY, LITTLE SILT,
		· ·			<u> </u>	NO ODOR, DAMP
		·				27.0 - 27.3 BROWN SAND, SATURATED.
		Ļ				NO ODOR
						27.3 - 28.0 GREY CLAY, LITTLE SILT. DAMP, NO ODOR
						DAMF, NO COCH
		' [
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		. [
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SHIT

PROJECT NUMBER SCRING NUMBER

58-09

SHEET / OF

SOIL BORING LOG

LEVATION	ETHOD A	ND EQU	IPWENT.	Atten 5	TART NO 20 - 34 PINISH		LOGGER BTB
FATER LEVI							COMMENTS
TATES CEVE		لاحسو		STANDARD	· SOIL DESCRIPTION		
DEPTH BELOW BURFACE	MTERVAL	TVPE AND HUMBER	RECOVERY	TEST NESULTS 6'-4'-4' (N)	NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	001 000 001	DEPTH OF CASING. DRILLING RATE DRILLING PLUID LOSS. TESTS AND INSTRUMENTATION
2 2 2 2	-	-2	-		0-0.7 ' Conc. Pul	4	HAL WGI 2-25 M
1.	V	\$-01 -01	. 9*	9-21-16	0-2' Par Grand 2-9' Course Grand Fill	-	HNU who 250 pm
3		48-29 -02	13 ^H	K-12-10	rather brown solly chy algrand Form. moist.		Me you rope
4	$\langle \rangle$	(UP) 58-09 -03	15"	15-12-10	some as above . Bottom 64 softe and appears to her and chy		How really between yes + 20 ppm
	X	48-91 -04	184	2-2-3	Some as in Home of white. Across parting goods to gray in with matthe.	1	who you copper
8	X	-05 -05	igk	4-7-4	and from sity alog u/grand and soft. resort trans		HHE yt 9pm
9	X	93-19 6	18*	6-8-13		- }	HAL gh 5
10- H -	X	: 53-41 -07	13*	2-8-9	8-13° gry bran sily city -/gr.	7	19 12 ops 20 pg
12.		•				1	
						4	

															ELEVATION	\$	2 6	1 0	1	T::C	Ω
 26-	24-	li li	<i>L</i> ,	/8-	12-	14-	7		6 .	ø,		1 4		. 1	DEPTH BELOW SURFACE	WATER CENTER	ORILLING METHOD AND EQUIPMENT	PROJECT _		TI TI	3
	X					X			X						INTERVAL		A BOHT	3.2	' \		
	1-35		\$2.3			2-55			1-55			,			TYPE AND NUMBER	SAMPLE	NO EOÚ	917	1		
	/4.		٠٠.		,	4.			P.				···		RECOVERY		PMENT				
	11-26-38		8-13-14			-47-54			4-10-16			, ,			RESULTS 6-4-4-	STANDARD	Mobil	136.			
	10 mm	2:14° C1°		Sik, Clay		2		to mat		5:11. C/e	•	.••			NAME. PARTICL MOISTUF OR CON MINERAL		3-61 D	Z L		W65 230.	7 41
·	1, 7, 7, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	C. C.	900-	, De. KG		•	Liebt Brown.		- e	シャ			•	•	NAME, GRADATION OR PLASTICITY. PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SOIL DESCRIPTION	11/2/84	CONTRACTOR -		Ú	7 ×
d		3/2 40	I,st	7. Same 5			File	-/o.	5/4/5	i i	•				IN PLASTICIT BUTION, COLO ELATIVE DENSI ILL STRUCTUR IQUP SYMBOL	PTION	FINISH	HT.	LOCATION	SOIL BO	BORING
 •	3.0			<u> </u>	16.5'	1 .	, j.	امر		Sa.	1		. I I.		, E T E T		11/2/84		SOUTH	ING	ECC -/OA
 -8				/-/	<u> </u>						··		<u> </u>		SYMBOLIC LOG	-			io Fi	LOG	
	-				gravel at	Red Clatter					•			the reading	DEPTH OF CASING. ORILLING FAUD LOSS. TESTS AND INSTRUMENTATION	COMMENTS	LOGGER J. H. Jo		FENCE ACUANT	1	SHEET
	n	· • •			15 th.	, passil			;			••		45.0 ×	SING.	. X	Johnson		r- CoA		9.

ENVIRON

650 Dundee Road, Suite 150 Northbrook, Illinois 60062

GEOLOGIC DRILL LOG

BOREHOLE NO.: T-9 TOTAL DEPTH: 34.0'

PROJECT INFORMATION

PROJECT:

ECC: Monitoring Wells

SITE LOCATION: JOB NO.:

Zionsville, IN 21-6585B

LOGGED BY:

Scott Hayter

PROJECT MANAGER: Ron Hutchens

DATES DRILLED:

5-5-98

DRILLING INFORMATION

DRILLING CO.:

EDAC

DRILLER:

Dan Dreyer

RIG TYPE:

Gus Peck GP-1300

METHOD OF DRILLING: hollow-stem auger SAMPLING METHODS:

split spoon

HAMMER WT./DROP

140 lb., 30 in.

NOTES:

SS INTERVAL (ft) SS RECOVERY (ft) BLOW COUNTS PID (ppm) DEPTH (ft) GRAPHIC LOG USCS LAYER DEPTH (

SOIL DESCRIPTION

		T	1	ე0 -			•	SILT; field observation
0-10		no sampling		-5 -				
10-12	0.5	1, 2, 3, 6	<1	-10-		мн		SILT: Gray-brown silt with a little clay, a little sand, and a trace of gravel. Dry.
12-14	0	4, 5, 5, 8	<1	-15-	7.77		14.0	SILTY CLAY: Dark gray-brown silty clay with a trace of fine gravel and few sand. Moist.
14-16	1.5	3, 4, 6, 8	<1					THE BIAVE MICH SMICE STATES
16-18 18-20	1.5	1, 1, 3, 4	<1	-20-	7-7-7	CL .		
20-22	1.1	1, 1, 2, 2	<1		7-7-7	-		
22-24	1.8	1, 1, 2, 4	<1	-25-	7-7-7			
24-26	1.4	1, 1, 3, 4	<1		7-7-7		26.7	SAND: Medium to coarse sand with a trace of fine gravel.
26-28	2.0	1, 1, 1, 4	<1	30				Dry.
28-30 30-32	2.0	2, 2, 4, 8	<1	-30-		SW		
32-34	2.0	5, 13, 48, 48	<1			мн	33.2	SILT: Dark brown silt with a trace of clay and a trace of fine gravel. Dry.

ENVIRON

650 Dundee Road, Suite 150 Northbrook, Ilinois 60062

WELL CONSTRUCTION LOG

MONITORING WELL NO.:T-9
TOTAL DEPTH:25.5'

PROJECT INFORMATION

PROJECT:

ECC: Monitoring Wells

SITE LOCATION:

Zionsville, IN

JOB NO.:

21-6585B

LOGGED BY:

Scott Hayter

DATE(S) DRILLED:

5-11-98

DRILLING INFORMATION

DRILLING CO.:

EDAC

DRILLER:

Dan Dreyer

RIG TYPE:

Gus Peck GP-1300

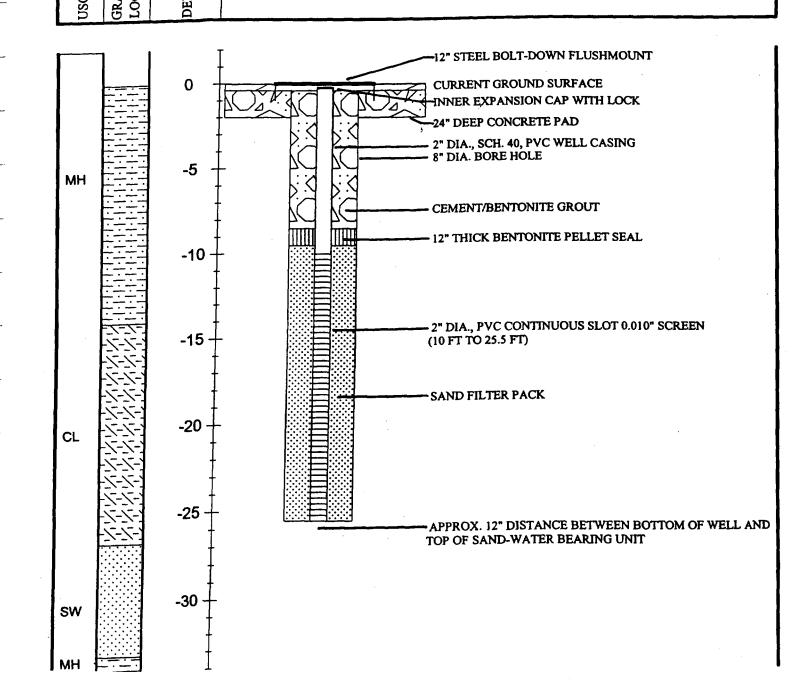
METHOD OF DRILLING: hollow-stem auger

BORE HOLE DIAMETER: California split spoon

SURVEY COORDINATES: 921571.18N 725827.61E

T.O.C. ELEVATION:

WELL CONSTRUCTION



APPENDIX C

Diffusion Model

Appendix C

Molecular Diffusion and Decay Transport Model Equations

The following equation describes the change in contaminant concentration over time based on molecular diffusion and decay,

$$\frac{\partial C}{\partial t} = D_{eff} \frac{\partial^2 C}{\partial x^2} - \lambda C$$
 C-1

$$D_{eff} = D_{w}\theta_{t}$$
 C-2

where C is contaminant concentration, t denotes time, D_{eff} is the effective diffusion coefficient, x is the vertical distance between the contamination and the ground water, λ is the decay constant, D_w is the chemical-specific diffusivity in water, and θ_t is the total porosity. At steady state (i.e., when the diffusive flux no longer changes with time), the solution to the equation is 1

$$C = C_o \exp \left(-x \left(\frac{\lambda}{D_{eff}}\right)^{\frac{1}{2}}\right)$$
 C-3

where C_0 is the source concentration. The diffusive flux (mass per time per area), J, into the ground water is, by definition,

$$J = -D_{\text{eff}} \frac{dC}{dx} \bigg|_{\text{till/water interface}}.$$
 C-4

¹ Equation was solved by analogy to the heat conduction equation solution presented in Conduction of Heat in Solids, H.S. Carslaw and J.C. Jaeger, Oxford Science Publications, 1959, p. 135.

The expression $\frac{dC}{dx}\Big|_{till/water\ interface}$ is the contaminant concentration gradient evaluated at the till/water interface. The rate of mass transfer (mass per time, or M) can then be calculated by multiplying the flux by the area of contamination [length parallel to ground water flow (L) times width perpendicular to ground water flow (W)].

$$M = J \cdot L \cdot W$$

The contaminant concentration in the underlying ground water resulting from the mixture of the contaminant flux in the ground water can be calculated by dividing the rate of mass transfer by the volumetric flow rate of ground water. The volumetric flow rate of ground water (Q) is represented by the following expression.

$$Q = K \cdot i \cdot W \cdot d_{mix}$$
 C-6

where K is the hydraulic conductivity, i is the hydraulic gradient, and d_{mix} is the depth of the mixing zone. The resulting ground water concentration is therefore

$$C_{gw} = \frac{M}{Q} = -\frac{LD_{eff} \frac{dC}{dx}\Big|_{till/water interface}}{K \cdot i \cdot d_{mix}}.$$
C-7

An analytical expression for $\frac{dC}{dx}$ can be obtained by taking the derivative of Equation C-3.

$$\frac{dC}{dx} = -C_o \left(\frac{\lambda}{D_{eff}} \right)^{\frac{1}{2}} exp \left(-\left(\frac{\lambda}{D_{eff}} \right)^{\frac{1}{2}} x \right)$$
C-8

Evaluating this expression at the till/water interface (d_{till}), substituting the resulting expression and rearranging for $\frac{C_o}{C}$, which is the effective dilution attenuation factor for diffusion transport (DAF_{dif}), we get

$$DAF_{dif} = \frac{C_o}{C} = \frac{K \cdot i \cdot d_{mix}}{LD_{eff} \left(\frac{\lambda}{D_{eff}}\right)^{\frac{1}{2}} exp \left(-\left(\frac{\lambda}{D_{eff}}\right)^{\frac{1}{2}} d_{till}\right)}$$
 C-9

Note that the C_o in the above expressions refers to the water concentration in equilibrium with the soil concentration, so we must incorporate the equilibrium leaching equation² in order to calculate the IDEM RCRA clean closure level for soil (C_{soil}). The resulting expression is

$$C_{soil} = C_{gw target} \times DAF_{dif} \left[K_d + \frac{\theta_w + (\theta_a \times H')}{\rho_b} \right]$$
 C-10

where K_d is the product of the chemical-specific organic carbon partitioning coefficient, K_{oc} , and the fraction of organic carbon, f_{oc} . The chemical-specific input parameters (K_{oc} , H', Dw, and λ) used in the Tier 3 calculations are given in Table C-1, along with their respective sources. The site-specific physical parameters (f_{oc} , ρ_b , θ_t , θ_a , θ_w , d_{till} , L, K, i, and d_{mix}) used, along with the rationale for their selection, are given in Table C-2.

² RISC Technical Resource Guidance Document, February 18, 1999, Equation 8-1, p. 8-4.

Table C-1
Input Parameters – Chemical Specific
ECC Southern Concrete Pad

Parameters	Units	PCE	1,1 DCA	1,2 DCA	1,1 DCE	cis 1,2 DCE	MC	1,1,1 TCA	1,1,2 TCA	TCE	VC	Source
Target Level for												
Ground Water ¹	mg/L	0.005	0.99	0.005	0.007	0.07	0.005	0.2	0.005	0.005	0.002	RISC ²
K _{oc}	l/kg	155	31.6	17.4	58.9	35.5	11.7	110	50.1	166	18.6	RISC ²
H ¹	unitless	0.754	0.23	0.0401	1.07	0.167	0.0898	0.705	0.0374	0.422	1.11	RISC ²
$D_{\rm w}$	cm2/s	8.20E-06	1.05E-05	9.90E-06	1.04E-05	1.13E-05	1.17E-05	8.80E-06	8.80E-06	9.10E - 06	1.23E-06	TACO ³
λ	day ₁	9.60E-04	1.90E-03	1.90E-03	5.30E-03	2.40E-04	1.20E-02	1.30E-03	9.50E-04	4.20E-04	2.40E-04	TACO ³

¹Detected as C_{gw} target

³TACO = Illinois EPA Tiered Approach to Corrective Action Objectives, Final, July 1997.

PCE = Tetrachlethylene

1,1 DCA = 1,1 - Dichloroethane

1,2 DCA = 1,2 - Dichloroethane

1,1 DCE = 1,1 - Dichloroethylene

cis 1,2 DCE = (cis) 1-2 Dichloroethylene

MC = Methyl Chloride

1,1,1 TCA = 1,1,1 - Trichloroethane

1,1,2 TCA = 1,1,2 - Trichloroethane

TCE = Trichloroethylene

VC = Vinyl Chloride

²RISC = RISC Technical Guidance Document, Draft February 1999

Table C-2
Input Parameters – Site Specific
ECC Southern Concrete Pad

Parameters	Units	Values	Source
			Total organic carbon data presented in the ERM Technical Memorandum Soil Organic Carbon (January
			25, 1996). The average of the foc measurements from the intervals between 4 and 10 feet, excluding
f _{oc} - fraction organic carbon	D	0.00964	B103, B105, and B115 (the obviously impacted borings) was selected.
P _b . Soil Density	kg/l	1.5	RISC Technical Resource Guidance Document, Feb. 18, 1999, p. Ap.1-35
$ heta_{t^{-}}$ total porosity	g/cm ³	0.21	Versar soil test data from table dated 2/28/98. The average of all reported measurements was selected.
θ_a – air filled porosity	D	0.08	Versar soil test data from table dated 2/28/98. The average of all reported measurements was selected.
$\theta_{\rm w}$ – water filled porosity	D	0.13	Versar soil test data from table dated 2/28/98. The average of all reported measurements was selected.
d _{till} – depth of till	feet	3	Versar Geotechnical Survey Report, dated 4/8/98.
L - length of source area			Largest source length for all compounds. The source dimensions were based on area of soil
parallel to ground water flow	feet	60	in excess of Tier 1 screening levels for each compound - see Figure C-1.
			The leaves of the recovery of the Newsylvan December should be 40,000 from Table II 1 of the
			The lesser of the geomean of the November –December slug test results (0.009 from Table H-1 of the
	,	0.004	Third Site Field Investigation Data Report) and the geomean of the historic hydraulic conductivity test
K – hydraulic conductivity	cm/s	0.006	results (0.005 cm/s from Table 2-1 of the 1988 CH2M Hill Tech Memo) was selected.
l			Based on August 9, 1999 water level observations as reported in the 3/16/00 letter report to Michael
i – hydraulic gradient	D	0.004	McAteer of the USEPA.
d _{mix} – depth of ground			
water mixing zone	cm	200	ASTM 1939-95 RBCA Standard default.

D = dimensionless

